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The Whitlock Vertical Engine.

We illustrate with this a vertical engine, in the design of which two features of considerable importance have been incorporated, viz.: the locating of all the adjustable parts so they may be come at for adjustment with ordinary tools, and the lightening of the reciprocating parts to the greatest extent compatible with securing the necessary strength—an important consideration in the instance of a vertical engine where lightness of reciprocating parts is generally held to be essential.

The upright frame consists of a tapered rectangular column, cast in one piece with the base. Instead, however, of the working parts being situated inside this column they are located on its outer face, the cylinder being bolted against it near the top, and the crank shaft boxes cast with the column, a recess in the face providing room for the crank.

The valve is a plain slide, made with lap to cut off as early as is practicable with a valve of constant travel, and providing for cushion sufficient for smooth running. The speed is controlled by a sensitive throttling governor. The exhaust steam is conducted immediately back and passes out through the hollow column to the rear of the center of the cylinder, horizontally.

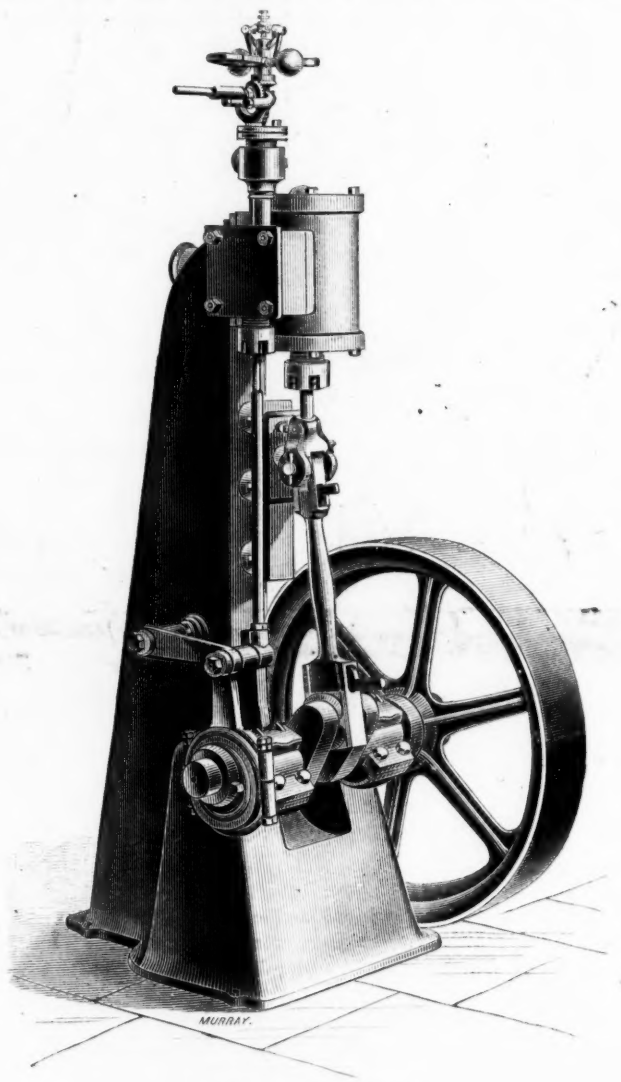
The cross-head slide is cast with the column, and presents a large flat-wearing surface for the adjustable gib of the cross-head.

The cross-head is light, the piston is made hollow, with thin walls, and the connecting-rod is of cast steel cored so as to leave a thin shell of metal only, by which means the requisite strength is obtained, while at the same time it is quite light. The connecting-rod brasses are adjusted by means of gibs and keys.

The crank shaft is of cast steel, and the main journal boxes are lined with a composition consisting almost entirely of copper and tin. The necessity for liners under the caps of the main bearings is obviated by the use of screws through the caps, which abut against the box outside the bearings. By adjusting the screws and tightening the cap bolts the caps can be rigidly bound with the shaft just free to revolve. By the use of these screws it is also possible to adjust the caps very accurately.

The stuffing-boxes are large in diameter, and deep, while their position provides for their being adjusted with the engine in motion, even in the smallest sizes of engines, without danger of accident. The main caps can also be as conveniently adjusted with the engine in motion, and all working parts outside the cylinder are open to inspection without stopping for the purpose.

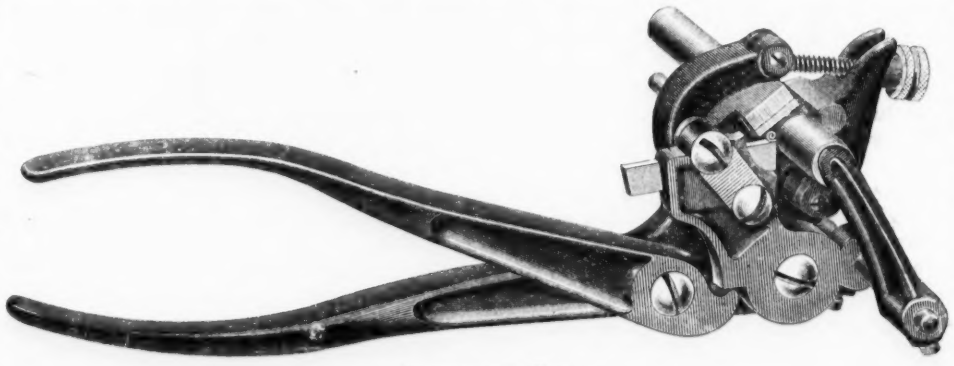
In this engine no claim is made of getting the most power into the least space, but rather the convenient location of all the parts so that they shall be accessible, while presenting reasonable compactness and amplitude of wearing surfaces. A fairly high rotative speed is employed, without, however, approaching very near to the limits of high speed; that is, it is not claimed that this is distinctively a high speed engine. These engines are made by Seymour & Whitlock, Newark, N. J.



NEW VERTICAL ENGINE.

Elliott's Cutting-Off Tool.

We present with this an engraving representing a tool which possesses the merit of combining a good deal in little space, and at a nominal cost. This little tool, which is made by Sterling Elliott, Newton, Mass., is designed for cutting up round stock—the one shown cutting from $\frac{3}{16}$" to $\frac{1}{2}$" inclusive—by the use of an ordinary lathe, for which purpose a speed lathe is quite as good as an engine lathe, as no tool-post or back-rest is required in its use.



CUTTING-OFF TOOL.

In its construction the tool consists of two handles, the end of one of which is fashioned into a V rest for the stock, the V being lined with hardened steel. To this handle is pivoted an adjustable swinging piece, which is armed with a hardened steel pin, and being, by the aid of the thumb nut, adjusted to the rod, forms the third bearing surface of the rest. To the lower side of the forward part of this arm is also pivoted the tool holder, which is so arranged that by closing the levers, as in using a pair of plyers, the cutting tool is brought into contact with the rod to be cut.

An adjustable stop or gauge is attached, by means of a small rod, to the swinging arm which carries the cutting tool, and can be removed when its use is not desirable.

The operation of this tool is as follows: The rod to be cut up is held in the lathe chuck, projecting beyond any desired distance, and arranged to revolve at the same speed as for turning. The tool is placed upon the rod, and the movable jaw of the rest adjusted to a bearing. If several pieces are to be cut to a length, the gauge is adjusted, the tool moved along the rod till the gauge-stop comes in contact with the end, the handles pressed together, which moves the cutting tool up to the work in such a way that it will come exactly to the center, thus cutting the piece entirely off, no adjustment of the tool ever being necessary to provide for its cutting to the center, except keeping the cutting edge (which is not in this respect changed by grinding) at a distance specified in the directions from the part in which it is clamped. As the tool is moved up to cut, by the same operation the gauge is moved back out of contact with the end. When the pressure on the handles is removed, a spring returns the cutting tool to its original position, and also brings the gauge in position for determining the length of the next piece to be cut. The operation is repeated by simply moving the tool along the rod, the cutting up being done with great rapidity and accuracy. It will be noticed that all the appliances for cutting, gauging, &c., being a part of the tool itself, if the rod runs out of truth—in other words, wabbles—it will have no effect on the cutting, the rod to be cut forming the gauge for all the operations required; also that comparatively no time is lost in adjustment between the several pieces to be cut from a rod.

The cutting tool is a piece of steel of the proper thickness, cleared on the sides by concave grinding, and furnished for a few cents each. It is held in place by a clamp and two small screws, and requires grinding on the end only.

Extracts from Chordal's Letters.

TIME-KEEPING SYSTEMS—SYMBOLIZED TIME-KEEPING IN THE YORKTOWN SHOP.

Mr. Editor:

* * * Recurring to the workingman's slate upon which he keeps his time: Let it be understood that by slate I mean whatever the time is kept on, whether it is a real slate, or a time card, or the back of a piece of sandpaper, pencil marks on the shop wall or chalk marks on a planer bed.

* * * One very common plan of time-keeping is sending the time-keeper around with a book to take up yesterday's time from each workman. The workman looks at his slate, or his ticket, or his memorandum book, or his wall, or what-not, and furnishes the information. After the time-keeper has got it down, he cleans off his slates or whatever it may be, and destroys the paper, if it is such, and that ends it so far as he is concerned.

* * * This is wrong to start on. The only proper record of the time made by a workman is the original record made by the workman himself; no one but the workman can keep this original account, and without regard to what system of auditing it has to go through, it is folly to destroy the original, and go to the expense of making a mere transcript.

It may in some cases be said that a time-

keeper having nothing else to do knows the name of everything and can therefore supply deficiencies in the workman's record, but this is a fault in the system, not a virtue.

* * * The basis of a time-keeping system should be instructions to a workman to do two things: First, to perform a certain operation, and next, to keep an accurate record of the time expended in performing that operation. This should be the sum and substance of a time record. The labor involved in keeping such a record consists simply in looking at the clock when he commences the operation, and looking at the clock again when he stops, and in noting it down on a time record. Nothing more should be expected of the workman; and as the whole accuracy of a cost system depends upon the accuracy of these starting records it is well to see beforehand what circumstances can influence their accuracy.

* * * Using the old example of engine construction, we will assume that John Jones is to plane a crosshead. The verbal instructions of the foreman might be, "Plane up that cro-shead and keep your time on it." Under such circumstances, John Jones, on finishing the job, might hand in a memorandum reading, "Planing that crosshead four hours" Such a time memorandum as this, reaching the office, is defective in many particulars, as it speaks of "that crosshead," when there may be fifty other crossheads of different styles and characters, requiring more or less planing, and belonging to different jobs all going through the shop at one time

And again, the crosshead may have been half planed when it was given to John Jones to plane, for John Smith may have planed it wrongly before Then, there is nothing on this time card to show that it was John Jones that did the planing, or how much he got a day. And John Jones may be an ignorant sort of a chap, who don't know four hours on the clock when he sees it, and he may not know how to write it down, when he does know it. He may have been only three hours on the crosshead, or he may have been five hours.

* * * To start on, the time should be kept on a card, or a ticket, or something which can go into the office to be properly posted. Second, it should bear John Jones' name, that it may be traced back to its original source. Third, it should specify the exact thing worked upon, in such terms, that, under no circumstances whatever, can it be mixed up with any other thing of similar or dissimilar character. Fourth, it should specify the operation performed, in terms full and explicit. Fifth, it should specify the time consumed in the operation. Sixth, it should carry its date with it; and seventh, it should carry its own checks for accuracy.

* * * It is well not to have workmen do any more writing than is absolutely necessary, for the simple reason that a great many workmen are not capable of doing this kind of work satisfactorily. For this reason I advocate that the workman's time-card should be simply his order to execute the work given to him by his foreman or whoever he takes his orders from, with the time of delivery forming part of the order. Let him surrender the time-card when the order is filled, and let the time be noted.

* * * The time-card as thus proposed has nothing whatever to do with the pay system, of which more hereafter; the whole object of the plan which I am now proposing being to furnish an accurate record of the time consumed in an operation.

* * * Let the time-card be a printed form, ordering a certain operation to be performed on a certain thing. There is a blank for the operation; in the crosshead case, the foreman fills it with the word "plane"; but how should he describe this crosshead, as the thing to be worked on, so as to distinguish it from all other crossheads on the face of the earth?

* * * This brings up the question of shop symbolism, a matter well understood in some shops, but not touched upon in others. A few words on the subject may not be out of place. I will illustrate the matter by taking the case of the Yorktown Engine Works. They build many different kinds of engines, and many sizes of each kind. Horizontal stationary steam engines they designate by the letter A; vertical engines, by the letter B; portable engine on wheels, by the letter C; same on skids, by the letter D; hoisting engines, by the letter E; locomotives, by the letter F; road engines, by the letter G. In this shop, through force of habit, the men never call a thing a vertical engine; they call it a B. In short, B means a vertical steam engine.

Now, if the crosshead which Jones is to plane is called "B crosshead," it is known that it is a crosshead for a vertical engine, and that is all that is known in regard to it, so far.

* * * The first vertical engine got up at the works was called B1, and its patterns were marked B1, and its cost accounts were carried along as B1. The next vertical engine which was got up at these works, much different in some respects from B1, was called B2, and the next one B3, and so on down; say, to B40. The difference between B10 and B12 may be a difference in entire design, or it may be a difference in size, or it may be a difference in some simple detail All the B10 engines are exactly alike, but they are not like any other engine made in the shop; there are no other engines like them.

The same may be said of any other style of engines which the shop builds. The letter simply shows whether it is horizontal, or vertical, or portable, or what-not, and the number after the letter shows what particular engine of that class is meant.

If John Jones receives an order to plane D16 crosshead, it shows at once that the crosshead belongs to a portable engine of the skid style, and that it belongs to a certain kind of a portable engine of the skid style; to wit, style called D16. This crosshead can never be confused with any other crosshead in the shop. It will simply be called a D16 crosshead, which is a short way of saying "A crosshead for a portable engine on skids, of the second kind that was got up in 1879."

Here you can see how much can be expressed by this short symbol, and how certain and free from error a system of symbols can be. It is astonishing how quickly the men in the shop take hold of a symbol plan. Let Jones see one of these engines at work fifteen years after he planes the crosshead, and he will at once say to himself, "There is an old E16," for it is in that form that this engine identifies itself in his mind.

* * * This will give an idea of the symbol system, and if this was all there was to it, J. Jones' order would read, "Plane D16 crosshead." But there is another feature: This engine, D16, was got up in 1879, and one engine was built. Soon after that a lot of six was built. Soon after that a lot of 10, and the next year 20, and the next year, may be, 50. This year 50 were started in one lot, and after the lot was well under way a second lot of 20 was started. Here we have made near 200 of these engines to any one of which this crosshead may have belonged; for, bear it in mind, all of these engines were exactly the same, being the regular D16.

The cost of each lot of engines built will differ. It is presumed that the more that are built in one lot, the less the cost will be, and for this reason the cost should be kept separately upon each lot. Without saying how much closer the cost record should be kept, it is safe to say it should be kept upon each lot anyhow.

* * * The Yorktown plan is to simply number each lot of these engines. The first engine they built was called Lot 1; the next six engines built they called Lot 2; the next ten engines started they called Lot 3; the next twenty engines started they called Lot 4; the next fifty engines built were called Lot 5; the next fifty Lot 6, and the next twenty Lot 7; hence we see that Lots 6 and 7 are now under way in the shop.

* * * John Jones' order should read, "Plane crosshead D16-7." It would tell the whole story. While the shop makes a thousand crossheads a year, and may be of fifty styles, and may be several lots of each kind each year, there is no mistaking what the "crosshead for D16-7" means.

* * * The symbolism goes further. There is no need in hunting after a shorter word than crosshead, and there is no mistaking what part of an engine a crosshead is, and there is only one about an engine; but unfortunately we cannot find a short word to describe every particular piece about an engine. For instance, there are bolts to hold the cylinder down, and to hold the heads on, and for the follower, and guides, and steam-chest, connecting rod, eccentric strap, pillow block; lots of them around a boiler, and most all of them of different kinds. It would require a terrible long name to describe some of these bolts. It would most always take three words, as cylinder-head bolt, pillow-block bolt, connecting-rod bolt, and so on. Even these three words are not sufficient in many cases. For instance, there are five bolts to the back cylinder-head, and one of these bolts is a half-inch shorter than the other four, in order not to go through into the steam port. Hence, to describe this bolt we would have to say, cylinder-head bolt, the one that goes into the steam port. Taking in view all of the bolts in the shop, the real, full name of this particular bolt would be "The bolt for the cylinder-head, the one that goes into the steam port in the 6x12 portable engine on skids, the second style got up in 1879, the second lot that was started in 1883!" How is that for a name for a bolt? How would that look on a slate, and how would it look on a cost-ledger?

The Yorktown people fix this thing as follows: In getting out the detailed drawings for an engine or anything else, each particular piece is given a number: pieces that are alike of course bear the same number. Assuming that D16 is composed of 800 different pieces, and that the drawing for this particular bolt bears the number 84; then, instead of this rigmarole, the name of this bolt would be called D16, lot 7-84. The word "bolt" does not occur in the name at all, but may be added, and is sometimes added, for convenience, but without such addition the above symbolical name tells the whole story, and distinguishes this particular bolt from the hundreds of thousands of bolts heretofore made and now under way in the Yorktown shop.

The crosshead of D16 is No. 32, for instance. Hence, John Jones' order would read, "Plane D16, lot 7, No. 32."

* * * I am giving this Yorktown way of doing things as a matter of illustration, and as a matter of interest to those not experienced in symbolism, but am not advancing it as the nicest way of doing business. I may give my own opinion some other time. But this I will say: In a large concern, doing a varied line of work, and carried on on business principles, there must be a systematic cost system, and in that cost system there must be involved a method of symbols; either the Yorktown plan or its equivalent.

* * * In the Yorktown Engine Works, the foreman, instead of saying to Jones, "Plane that crosshead and keep your time on it," would write on the order blank, "Plane D16, lot 7. No 34;" and in the time column he would write "2-15," which simply means that John Jones' time begins to run on this job of planing from a quarter past two, and keeps on running till something on this ticket shows a stopping. John Jones has written nothing on the ticket, and the foreman has done no more than to make a pencil mark or two to express in writing an order which he had to give anyhow—an order that the foreman always gives. The time having started on this job, it may stop upon completion of the planing and its acceptance by the foreman; at which time the foreman would note the hour and take up the time-card and give another order for some other job.

Before this crosshead is half done, the foreman may give an order to Jones to quit it and take up something else. In such cases he notes the time when he takes up the order, the same as if the job was done, and gives another order on the new job. Whatever time has been put in on the order by Jones, acting on this order, can be posted from this order, and any future order to finish the job, whoever the order may be given to—may be Smith will finish the job—will carry its own time with it.

* * * In the Yorktown shop they have drawings, etc, and all Jones had to do was to work to the drawings. But in the Snaptown shop there are no drawings, and the foreman would be very likely to tell Jones to "plane that crosshead just $\frac{15}{16}$ths scant wide, and with the cheeks 2" thick and 4" across. If the Snaptown shop used this order system, which is as applicable to the Snaptown shop as to the Yorktown shop, the foreman would make a sketch or a memorandum on the back of the ticket, or something, to guide Jones in his operations. Jones would thus have his order to do the work, and instructions how to do it. It is, in fact, his voucher.

It may be said of a time card of this kind that it requires absolutely nothing from the workman, except, perhaps, to write his name upon the card; and next that it requires the foreman to jot down something, instead of giving verbal orders; next, it secures time entries made by a man supposed to be capable of writing the English language; it identifies exactly the thing upon which the time is to be charged; it fixes the responsibility of acceptance upon some power superior to the workman, and, above all, it charges against a piece of work all the time properly chargable to that piece.

* * * In many shops it is the custom to give the man a job and then go into a lot of preliminary work; and then leave it to the workman to charge against the job such time as he considers actually consumed. For this reason, in many such shops the time turned in does not account for all the time paid for, the difference usually being charged to "shop," or some such account.

* * * The above system of time cards contemplates every sort of stoppage for tool repairs, shop delays, etc., and puts the charges where they really belong; it also gives an

FIG. 2

FIG. 1.

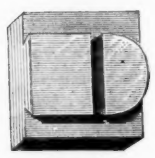


FIG. 5.

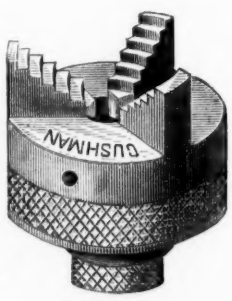


FIG 3.

FIG. 4.

NEW DESIGNS IN LATHE CHUCKS.—See page 3.

absolutely true basis on which to base a cost ledger. It multiplies time cards, but very slightly. A time card of the above character, bearing a date and the workman's name in his own handwriting, if he has one, and timed entirely by the foreman and by him turned into the office, I consider has embodied all the general essentials of the perfect thing. The matter of symbols, of course, has nothing to do with it, except as a matter of convenience, and as such the system of symbols can be at once simplified and made more full. This I may go into hereafter.

* * * Very respectfully,

CHORDAL.

New Designs in Lathe Chucks.

Opposite we present engravings of several forms of lathe chucks that are well worthy of inspection, and are convenient improvements for use on special work. The box body two-jawed brassfitter's chuck, Fig. 1, is of especial value, and is claimed to be an improvement over anything hitherto made for this kind of work, the bearing of the jaws being double the length of such chucks as usually made.

The round body brassfitter's chuck Fig. 2, is a good tool for general use, and is got out in excellent shape with a high degree of finish, the force being graduated and the slip jaws pinned in.

A convenient peculiarity of the watchmaker's chuck Fig. 3, is the large number of steps in the jaws, which will be found useful in holding the var ed forms of work.

The jaws of the drill chuck Fig. 4, give the hold on the drill an unusually long bearing, the advantage of which will be appreciated by every machinist. Fig. 5 is a detached view of one of the jaws of Fig. 2.

These chucks are made by A. F. Cushman, Hartford, Conn.

Reamers and Gauges.

At last year's meeting of the Master Mechanics' Convention Coleman Sellers was appointed chairman of a committee to investigate the propriety of recommending a "standard reamer for all bolts used on locomotive work, the proper taper to make it, and a system of gauges to correct and maintain a standard when worn." At the session just closed in Chicago, Mr. Sellers made his report in the form of a verbal address, which was illustrated by black-board sketches.

He said, in substance: In my own practice, taper bolts have not been used, but I felt that I was able to give an impartial judgment on the subject, because there is nothing of so much interest to the mechanical engineer at the present time as some tendency towards uniformity of practice. As the commission given to me calls for a decision as to the taper of bolts used in locomotive work, it pre-supposes that taper bolts are a necessity. In our own practice we divide bolts into several classes, and our rule is that in every case where a through bolt can be used it must be used. If we cannot use a through bolt we use a stud, and where a stud cannot be used we put in a tap bolt, and the reason why a tap bolt comes last, is because it is part and parcel of the machine itself. There are also black bolts and body bound bolts, the former being put into holes $\frac{1}{16}''$ larger than the bolt. It is possible in fastening a machine or locomotive together to use black bolts and body bound bolts. With body bound bolts it is customary for machine builders to use a straight reamer to true the hole, then turn the bolt and fit it into its place. It is held by many locomotive builders, that the use of straight bolts is objectionable on the score that if they are driven in tight there is much difficulty in getting them out, and where they are got out two or three times they become loose, and there is no means of making them tighter.

There is no difficulty in making two bolts of commercially the same size. But there is a vast difference between absolute accuracy and commercial accuracy. Absolute accuracy is a thing that is not obtainable. What we have to strive for, then, is commercial accuracy. What system can we adopt that will enable workmen of limited capacity to do work that will be practically accurate? The taper bolt for certain purposes presents a very decided advantage. Bolts may be made practically of the same diameter, but holes cannot be made practically of the same diameter. Each one is only an approximation to correctness. We have here an ordinary fluted reamer (showing an excellent specimen of Betts Machine Co.'s make). That reamer is intended to produce a straight hole, but having once passed through a hole the reamer will be slightly worn. The next time you pass it through it is a little duller, and every time you pass it through the hole must become smaller. There have been many attempts made to produce a reamer that should be adjustable. That, thanks to the gentlemen who are making such tools a specialty, has added a very useful tool to the machine shop,—a reamer where the cutters are put in tapered and can be set up and the reamer enlarged and made to suit the gauge. This will enable us to make and maintain a commercially uniform hole in our work. But the successful use of a reamer of this kind depends upon the drill that precedes this reamer being made as nearly right as possible, so that the reamer will have little work to do. The less you give a reamer to do the longer it will maintain its size.

The question of tapered bolts involves at once this difficulty: that we have to drill a straight hole, then the tapered reamer must take out all the metal that must be removed in order to convert a straight into a tapered hole. The straight hole is maintained in its size by taking out the least amount of metal. It follows that the tapered reamer would be nearest right, which would also take out the least amount of metal.

Mr. Sellers here exhibited a common reamer which he considered would answer for a hole of considerable depth, and compared it with a set of reamers made by Pratt & Whitney for the Baldwin Locomotive Works, which possess excellent features for doing exact work.

Then you come to the question of the shape of the taper. When I was engaged building locomotives in Cincinnati, a great many years ago, we used bolts the taper of which was greater than I shall recommend to you. In regard to the compression that would take place in bolts, no piece of iron can go into another piece of iron without being smaller than the hole into which it is intended to go. If it is in any degree larger, it must compress the piece itself or stretch the material that is around it. So, if you adopt a tapered bolt, you cannot adopt a certain distance that it shall stand out before you begin to drive it, for there will be more material to compress in a large piece than in a small one. Metal is elastic. Within the elastic limit of the metal you may assume the compression to be a spring. In a large bolt you have a long spring, and in a short one you have a short spring. If you drive a half-inch bolt into a large piece of iron, it is the small bolt which you compress; therefore the larger the bolt the more pressure you can give to produce the same result. Hence, if you adopt the taper bolt, you will have to use your own discretion, unless you go into elaborate experiments to show how far the bolt head should be away from the metal when you begin to drive it.

Certain builders of locomotives put their stub ends together with tapered bolts, but do not use tapered bolts in any other part of the structure. The Baldwin Works use tapered bolts wherever they have body-bound bolts. They make a universal taper of $\frac{1}{16}''$ to the foot. An inch bolt 12″ long would be $1\frac{1}{16}$ inch diameter under the head. They make all their bolts under 9 inches long $\frac{1}{16}$ larger under the head than the name of the bolt implies. Thus a $\frac{7}{8}''$ bolt would be $\frac{15}{16}''$ under the head, provided it was 9″ long or under. Anything over 9″ long is made $\frac{1}{8}''$ larger under the head, and still made a taper of $\frac{1}{16}''$ to the foot. A locomotive builder informs me that a taper of $\frac{1}{8}''$ to the foot is sometimes called for, and the Pennsylvania road calls for $\frac{3}{32}''$ to the foot. But the majority of specifications call for $\frac{1}{16}''$ to the foot. The advantage of $\frac{1}{16}''$ taper lies in the fact that a bolt headed in the ordinary manner can be made to fill the requirements, provided it is made of iron. You may decide that bolts should be tapered, for the reason that when a tapered bolt is driven into its place it can be readily knocked loose, or if that bolt, when in its place, proves to be too loose, you have merely to drive it in a little further—these are arguments in favor of tapered bolts showing their advantage. It is easier to repair work that has tapered bolts than work that has straight bolts. If you adopt a tapered bolt, say with a taper of $\frac{1}{16}''$ to the foot, you are going to effect the making of those bolts and the boring of those holes in a commercially accurate manner, so that they can be brought into the interchangeable system To carry this out, you require some standard to start with, and the simplest system that one can conceive is this: Let us imagine that we have a steel plug and grind it perfectly true. We have the means of determining whether that is a taper of $\frac{1}{16}''$, thanks to the gentlemen who are now making these admirable gauges. We have a lathe that can turn that taper. I think if you go into the manufacture of these bolts, you will be obliged to use a lathe which will always turn a uniform taper. Having made a gauge like Fig. 1, 8″ long and $1\frac{1}{16}''$ diameter with a taper of $\frac{1}{16}''$ to the foot, this is the standard of what? The area of the bolt, not of the hole it goes into. We now make a plug, Fig. 2. Taking that tapered plug we should be able to drop it into the hole. Your taper reamer is made to fit this, but you require to know how deep the hole should be. Remember, I said this is the gauge that the bolts are made by. Now let us suppose that we have this as a standard, and to that standard these reamers are made. We decide by practice how much compression we can put upon the metal. For inch bolts, and say all above $\frac{1}{2}$ inch, we might, say, allow the head to stand up $\frac{1}{8}$ of an inch. Let us make another gauge like this (Fig. 1), but turned down $\frac{1}{8}$ of an inch shorter. We then shall have the hole smaller than it was before. It is this degree smaller, .0065 of an inch; that is a decimal representing how much smaller that hole is when you have gone down $\frac{1}{8}$ of an inch on a taper of $\frac{1}{16}''$ to the foot.

Fig. 1

Fig. 2

Fig. 3

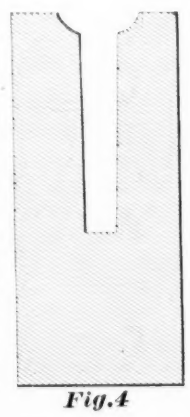


Fig. 4

Having got this tapered plug you then must have the means of making the bolts commercially accurate in the shop. For that purpose you must have some cast iron plugs. Those are reamed with a reamer that has no guard on it, but is pushed into it until the plug—this standard plug—is flush with the end of it. If you go in a little too far it is no matter. Having produced that gauge, we gauge first the one that is used on the lathe for the workman to work by, and he will fit his bolt in until the head will be pushed up against it. If you have a bolt to make from a straight piece of iron, I should advise its being done in two lathes. Here are those beautiful gauges of the Pratt & Whitney Co. which will answer the present purpose; one of these gauges measuring what the outside of the bolt will be, the other gauge $\frac{1}{16}$ of an inch larger will mark the part under the head. Messrs. Baldwin have a very good system of gauges. All the cast iron plugs which they use for this purpose are square. Holes are cut in the blocks the exact size of the bolts to be turned up, as shown in figures 3 and 4. The object of this is that there shall be no mistake as to what the gauge is. These gauges can be readily maintained, because they have to go back into the room to the inspector. He puts this plug in. If it goes in and fits flush, it is all right. If the plug goes in too far, it is worn. He then turns a little off the end and adjusts it.

Now practically through machine shops we find that we have to use cast-iron gauges. We take, for instance, 2-inch shafting. Shafting can only be commercially accurate. Therefore we make cast-iron rings and if those rings will go on the shafting it is near enough accurate for merchantable purposes. But this ring will wear in a certain time. Therefore it must not be used more than a certain number of days or hours. Here you have a system that is simple in the extreme. You have all this in two gauges, one gauge being made as a mere check on that tapered plug which is the origin of all things, the origin being $\frac{1}{4}$ or $\frac{4}{16}$, or a quarter of an inch shorter if the bolt is very large. There is where you have to use your own judgment. But having adopted something practical you then can use your reamer which is necessary to produce a hole of a given size. If this reamer wears, you then turn off this wrought iron collar far enough back to let it go in that much further. I know of no other way by which you can accomplish this result so well as by that in use at the Baldwin Locomotive Works. I think that the system originated with Mr. Baldwin himself.

I do not feel disposed to recommend to you any particular taper to be adopted, because it is not a question like that of screw-threads. In screw-threads we throw away the dies that are used upon bolts, which are perishable articles. The taper that has once been adopted in locomotive establishments is a perpetual thing. If the Pennsylvania Railroad and all its branches have adopted $\frac{3}{32}$, it is folly to ask them to change it to $\frac{1}{16}$ of an inch, because their own connections are large enough to make them independent of almost any other corporation, and the need of absolute uniformity in their work would cause them to stick to that particular thing. Any of you having five, six, seven, or two or three hundred engines, must make up your minds what you will do. When we adopt a standard for screw-threads a screw-thread is adopted which has a manifest advantage. A bolt that has one screw-thread can be used on any machine. But once having adopted a taper on a road, it is very difficult to make a change; and whether it is wisdom for this Association to say that thus-and-so shall be the standard taper, is a question I am unable to answer. Therefore I am unwilling to present any taper to you, and only present the facts, but will say that $\frac{1}{16}''$ is enough. The less taper you have the less material you have to cut away. But to say that $\frac{1}{16}''$ is preferable to $\frac{1}{32}''$ is folly, because no human being could tell the difference. If a bolt has 5° taper on the side, it may set in place; if it has 7°, it may jump out That is the angle of friction for iron or other metals. Five degrees would be an absurd angle for a taper bolt. Anything, then, that will hold; that is, if you drive the bolt it will set there.

This presentation may enable you to arrive at some conclusion. Nothing is more desirable than an interchangeable system. In making turning lathes we try to make all parts interchangeable, and we so fit the sliding spindle. Every sliding spindle in the dead head of the lathe has to be fitted into its own place We know of no method of making all holes of exactly the same size, that shall be commercially profitable. The only way we could surmount that difficulty was to put two conical sleeves in that should compress. We have so solved the problem. We now make spindles that are interchangeable, and we do not fit one part to the other. But that is not the case with bolts. You cannot put the compressing thimbles on them, therefore, you have to consider the question: How can you make holes near enough, and how can you turn the bolts near enough alike?

Crushing and Finning of Dry Sand and Loam Castings.

BY THOS. D. WEST.

In the previous issue, having discussed the joints of green sand moulds, in order to conclude the subject the question in relation to dry sand and loam mould would appear to be in order, the considerations of each branch being measurably distinct. A green sand mould, if the joint is not disturbed, will close as nearly air-tight as it is before parting. Even if there are irregularitics in the surface, they will yield and bed themselves in a way to make the joint tight. In a dry sand or loam mould, incompressibility of the material and the fact that the joint is distorted in drying will prevent this, so that the joint will either be kept apart or will crush in closing. "It is better to have a fin than a crush" is an old adage that has frequently to be learned by added experience.

With dry sand and loam moulds, then, it may be said that they should generally have a fin to prevent the probability of bad results. For this purpose the edges of the joint are cut or sleeked down, leaving an opening, as shown in the engraving at *K*. In sleeking for a fin there are three ways, in one of which it is usually done. Sometimes it is sleeked down at the edge of the pattern, as shown at *P;* then, after the cope has been rammed up and lifted off, the cope joint shows a varied edge, as at *B*. This raise is then cut off, as represented at *E*, after which it is sleeked down the same as the nowel at *P*. This makes a thick fin, which for some jobs is the safest, and hence the best, as, for instance, when there is a possibility of the joint being torn up in drawing the pattern, or when the flask is not well fitted.

The second plan, and one that makes a neat fin, is not to sleek down the joint as at *P*, but leave it level, as at *A*. After the cope is lifted, both joints are sleeked down, as shown. The pressure used in sleeking will, of course, to some extent regulate the thickness of the fin, but by this plan it would require very heavy pressure to provide for a fin as thick as by the first method, as by that a portion of the joint surface is cut away before it is sleeked, and the cutting away of the projection *B* not only lessens the surface, but also softens the sand so that it sleeks down easily. By the second plan a thicker fin can be made by swabbing the joint before sleeking, than by sleeking at its natural dampness.

Sometimes, with a good flask and a pattern that draws well, and particularly when the moulder is a careful man, sleeking down the cope half of the mould will be sufficient. This makes a thinner fin than when both halves are sleeked down, but its safety depends upon the ability of the moulder to get his work down to a fine limit.

For jobbing work I would establish the first plan, as it gives a doubt the preference. In such work ill-fitting, unhandy flasks must often be used, as well as poor patterns, so that the second plan named would involve too much risk to be adopted by the majority of moulders.

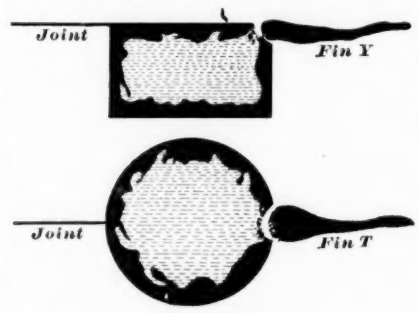
At *H* is pictured the cause of moulds being crushed, and the introduction of the castings to the scrap heap. The fin should be largest at the edge of the mould, and taper back to nothing, the width being from 2″ to 4″. As represented at *H*, this is not provided for, as, instead of an easy slant, the trowel is pressed upon the edge of the joint, raising up portions of the sand higher than the joint. When the cope is closed and the two joints come together, the raised portions touch first, and, of course, a crush is the result. As a rule, it is best not only to be sure of the opening for a fin at the edge of the mould, but also to sleek over the whole of the surface of the joint to make sure it does not touch hard in places, and that the joints of the flask shall come together, as shown on the side at *K*.

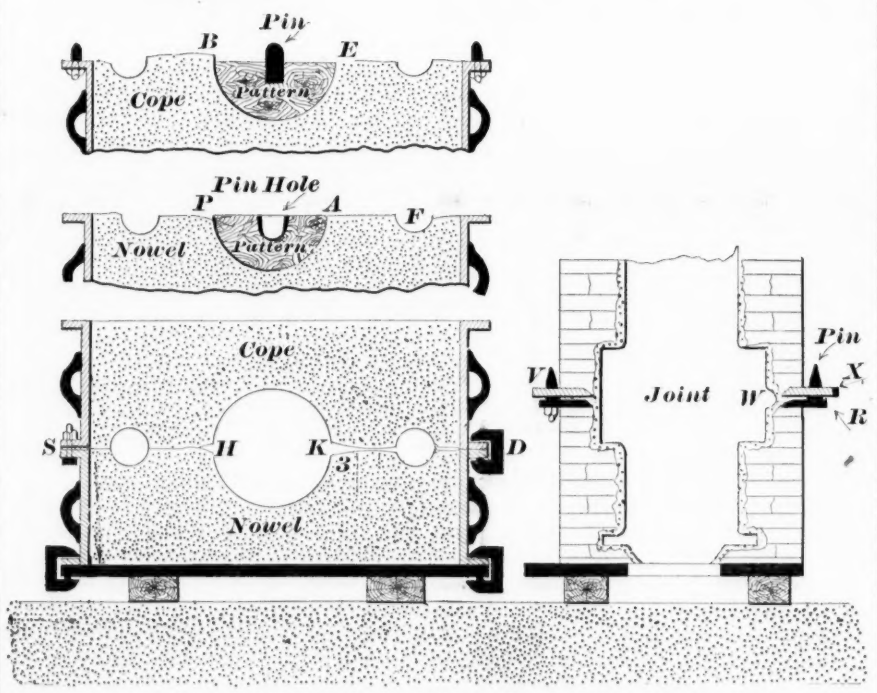
It should not be understood that because the joint side *K* shows a clearance over its whole body, that larger surface joints should be cut or sleeked down to allow of finning all over. The idea sought to be conveyed is that joints should not in any way prevent the flask coming together, as represented as doing at *S*.

When there is a large area of joint fin there is danger that the joint will hold the fin in shrinking, so that a piece will be pulled out of the casting, as shown in the cuts marked Fin *Y* and Fin *T*. I have often seen this result in cylinder and roll castings, the iron in which is generally hard, causing the fin to chill very quickly after the mould is poured, and, of course, in cooling, it shrinks. When the fin is large in area, or the joint irregular and the casting a thick one, there is the probability that when the fin commences to shrink it will pull away from the casting, taking with it a piece of the frozen surface or edge of the casting from the inner and fluid mass.

Sometimes a moulder may exercise proper care about the fin part of the joint, but be careless where a runner or gate is cut, as shown at *F*. It is essential that such parts should be finned, as the edges of the joint gates and runners can be crushed as easily as any other part. If they are crushed, it introduces dirt into the mould, and perhaps provides for a run-out.

To guard against crushing, care should be





DRY SAND AND LOAM MOULDING.

taken that the flask joints come together properly, and that they are not kept apart by dirt or rust. To this end, before starting to gagger or ram up the cope, it should be firmly bolted or clamped to the nowel, as represented at *D* and *S*. As a further precaution against the loss of a casting by the crushing of dry sand moulds, it is often advisable to close them together, bolt and clamp them, then hoist off the cope and examine the mould. In moulding cylinders in dry sand, this is especially to be commended. In some cases I have the mould closed before any cores are set; then, with a lamp inside the mould, the joints can be plainly seen, and felt if uneven or overshort; the thickness of fin can also be noted, and if found too thin can be cut out when the cope is raised up.

Before leaving the subject of dry sand joints, there is another point worthy of note. After the mould has been blacked the joint should be washed over lightly with the same blacking, thinned with beer or molasses and water to a degree that will just blacken the joint surface. The same treatment should be given the core prints, as it not only makes a better-looking mould, but by forming a hard skin prevents such parts from crumbling away when being brushed or handled. After blacking the joint should be sleeked to level down any lumps that may be on the surface. Often the blacking of the joint is neglected, or it is blacked with thick blacking, thereby increasing the thickness, making it liable to be crushed. Again, the joint will be wet until it is little better than a bed of mud, thereby getting out of all reasonable shape. Either of these last-named operations is likely to bring about bad results.

A consideration of the joints of loam moulds embraces more than can be covered with a single article in the space allowed. Some of the features connected with this subject have been referred to in previous articles, and a few points may be mentioned here. The joints of loam moulds should be finned upon the same general principle as those of dry sand moulds, but the finning is accomplished differently. Instead of sleeking down the joints, they are scraped or shaved off. Two points are illustrated, which, I believe, are not generally known or practiced. At *W*, in the cylinder loam mould, is shown a bead swept where the mould is to be jointed. By parting the joint in this way the fin can generally be chipped off and the surface smoothed with a file, so as to present scarcely any signs of the joint. This plan also provides for hiding overshotness, which will often occur in loam castings.

This bead is generally applicable to joints formed by a sweep, and for irregularly-formed joints that require hand-work can sometimes be used.

Sometimes sections of loam moulds are swept independently of each other, and closed together in getting ready to cast. For such moulds the sweep can be made so as to form the fin. In this way the fin will be quite even in size, giving the casting a symmetrical appearance. Fins at their best are not an element of beauty, and the refined moulder will study to see that they mar the general appearance as little as possible.

Steel Hardening Fallacies.

BY S. W. GOODYEAR.

It has occurred to me that a statement of some of the beliefs, practices, and fallacies of many men, who, fully believing that they know all about steel, fail to comprehend the most important, while most simple facts might put the subject in such light as to occasion research and experiment resulting in much good.

Said a man in my hearing, "I have hardened steel for thirty years, and know how to heat steel, and how hot it should be for hardening; and I tell you, in relation to steel springing and getting out of shape in hardening, it all depends upon how it is dipped into the water. I can harden dies and cutters, and have them come out as true as when they left the tool-maker."

It is an unquestionable fact, that the manner of dipping has much to do with this matter, but our friend should remember that his action is governed by natural law, as much as are the actions of others; that steel springs out of shape in the fire from uneven heating; that it springs in heating, owing to an unequal and unnatural tension of some parts produced in forging; that difference in section at different points in a piece will cause more sudden cooling and contracting in some parts than in others; that some steels at the hardening heat will, in dipping, change in volume more than others; that with different steels all the different heats may be required for hardening, ranging from a yellow heat by daylight to a dark-red by twilight; and, finally, after considering all the tendencies toward distortion and change in volume, resulting from a variation in any way from the best treatment possible, or a variation of quality or condition of steel from the best, there still remains this fact, that the steel by heating is expanded, and by sudden cooling, for hardening, is very much contracted from its volume while heated. As the outer portions cool first sufficiently to become hard and unyielding, while the interior of the piece is still hot and largely expanded, there must be a change in shape or volume, or both, produced by hardening.

Was a piece of steel of any considerable size ever hardened, remaining exactly the same size and shape as before? Who believes the steel manufacturer, when he says his steel will do it; or the skilled steel worker who says, "I can do it every time?" No, my friend, you are mistaken all around; your work don't come out true, but only *nearer* than by some worse methods. And it is not *all* in the way you dip it. If what you say were strictly true, there would be "millions in it."

Say another class of men, "We want no case hardening, but want steel hardened clear through;" and when they see milling cutters or dies packed in burned leather for heating, they condemn that style of hardening, and insist upon doing their heating in an open fire. Good work can be done in either way, and heating by packing has its advantages over open-fire heating, in that it is usually more even, and if the steel heated in this way is not too hot, when ready for dipping, it is pretty certain that no part of it has been too hot at any time during the heating process. This is too often not true of open-fire heating. By packing with leather or charcoal the surface of the heated steel is kept clean until ready to dip; whereas, by open-fire heating, the impurities in coal not thoroughly coked, or foreign substances or cinder in the fire, produce a coating which interferes with the action of the cooling medium and prevents proper hardening.

Who believes that a piece of steel, of same quality and temper, heated in an open fire to the same heat of another which is heated in a box packed with burned leather, will be hardened any deeper than the so-called case-hardened piece? If it be true—and who disputes it?—that heating steel to a certain heat and suddenly cooling it is what produces hardness, is it reasonable to suppose that there would be any appreciable difference in the depth of hardening between the two pieces, provided they were equally hot, their surfaces equally clean, and the same conditions in cooling were preserved? Why should there be?

But as to the hardening clear through, *no steel piece of any considerable size hardens clear through*. Harden a piece two inches square as hard as possible, and break it, and the hardened portion will be found to be a mere shell, less than $\frac{1}{4}$″ thick, and, in many cases, not exceeding $\frac{1}{8}$″. Inside of this hardened shell it may be cut at pleasure with good tools. Still, there is much said about hardening clear through; and cases have been known where pieces of hardened steel, on being accidentally broken or cracked in hardening, have been condemned as nothing but case hardened iron, because they were found not to be hardened clear through, and the self-constituted judges have insisted upon

the correctness of their decision, even against the most unquestionable evidence, that the pieces were a high-grade of cast steel.

There are those who believe that success depends almost entirely upon what the steel is dipped in, not how it is dipped—for many of these pour their heated work in haphazard—and so we have tallow, and tallow and oil; and tallow, oil, and resin; and tallow, oil, resin, and beeswax; while sperm, lard, fish, whale, neat's foot, linseed, and all other oils are recommended, each by itself, or mixed with some other or others, or with something else, until the list of compounds, each having its advocates, covers nearly everything which is greasy and sticky and disagreeable to use.

It is fully believed by some, that the peculiar toughness and elasticity required in steel springs are due to the action of the oil or tallow in which they are quenched for hardening. It is also thought in many articles of manufacture, which spring in hardening and are straightened during the process of drawing the temper, that the fact that hardened steel may be straightened or bent at pleasure, when heated to a proper degree, while still hard enough to snap like glass on cooling off, is due to their having been hardened in oil or some greasy compound.

In many places, the proprietor and one or two trusty men have guarded for years the important secret pertaining to the ingredients and proportions of a nasty mixture, in which steel may be hardened, and then, by warming up till the oil on the surface smokes well, or till the temper is nearly drawn to the required point, may be bent or straightened. Well does the writer remember seeing the proprietor of an establishment engaged in the manufacture of garden hoes and hay forks, more than thirty years ago, show up the wonderful possibilities in this direction contained in a forty-gallon cast-iron kettle, without the contents of which he appeared to honestly believe he would be obliged to give up business.

Says a watch-spring maker, "I know about this. I have tried hardening in water, and it won't do. I have tested the matter thoroughly; have heated springs exactly alike, and hardened part of them in water and the others in grease, and those which were hardened in water would not do at all, while the others were good. Repeated experiments have satisfied me on this point."

"But, my dear sir, you say that you heated to the same heat for dipping, in both the water and grease. That is not right. Did you ever experiment till you learned the lowest heat at which water would harden the springs—a heat, in fact, at which they would not have hardened in oil—and try them in that way?"

"No, I did not do that; I tried everything else," is the reply.

And now let us ask a question of the man who has been exhibiting his exceptional knowledge, by hardening a piece of steel in his pet compound and heating it up till it smokes well, bending it over the corner of the anvil with a hammer, after which he cools it off and shows us that it will snap like glass.

"Did you ever try a piece in the same way, hardened at proper heat in water, or a piece heated after hardening with no oil or grease of any kind used?"

"It would be no use," he replies.

Try it, my friends; and, to you who have not tried straightening hard steel, by heating it, let me say that you have missed learning a good thing.

The suggestion is made that in 1892, nine years hence, the four hundreth year of the discovery of America be celebrated throughout the United States.

Abstract of a Paper read before the American Society of Mechanical Engineers on "A New Form of Balance Dynamometer."

BY S. S. WEBBER, LAWRENCE, MASS.

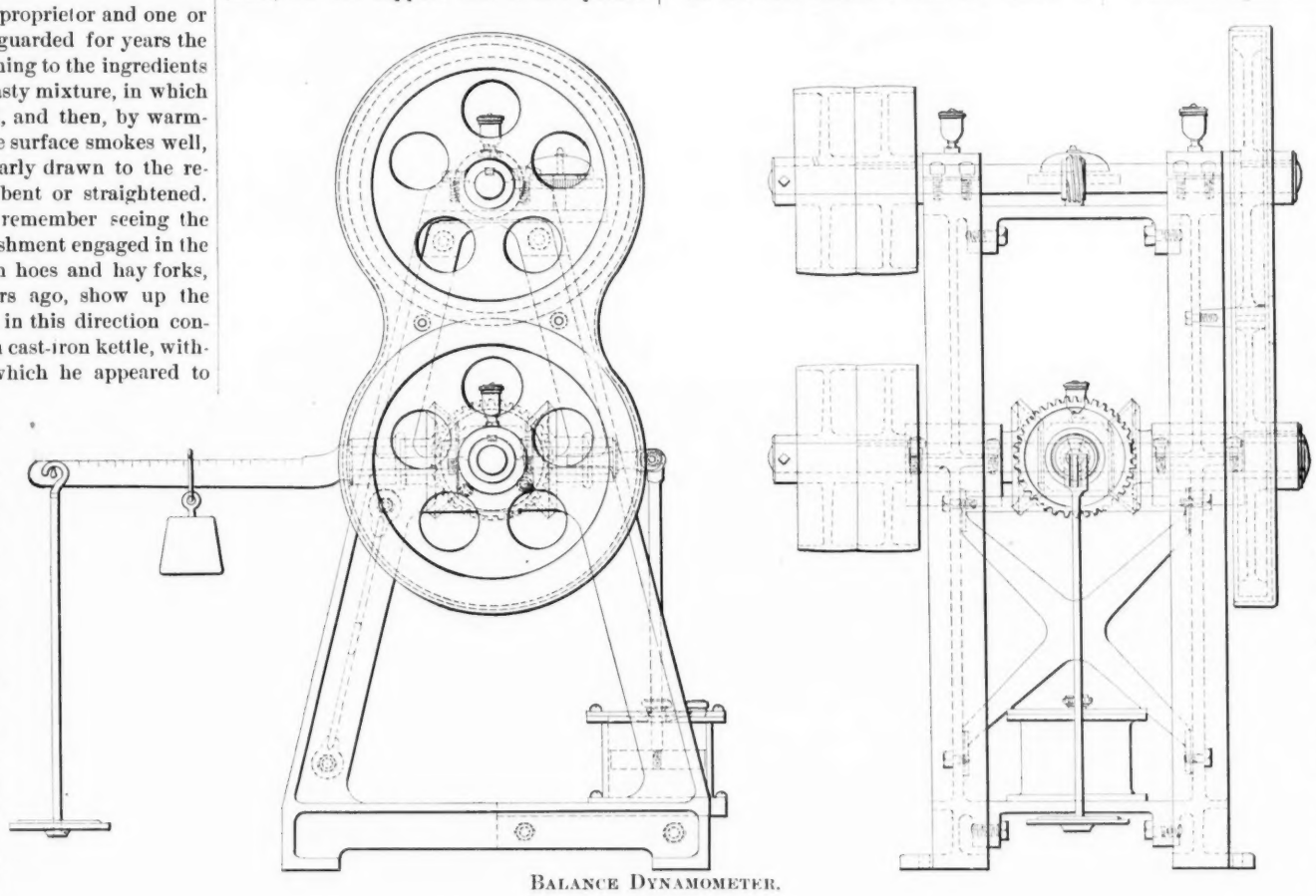
The balance dynamometer represented by the accompanying drawings was originally invented by Samuel Batchelder, in 1836.

The principle of the instrument is, that to hold a weight by the radius of a circle, in a horizontal position, at a constant distance from its center, takes as much power as to lift the same weight through the distance which would be traversed by it in any given number of revolutions around said center or axis, and in the time required for such number of revolutions.

Thus, in the present instance, the scale-beam or steelyard is the radius of a circle, of which the circumference is ten feet, and the pin on which the weight is suspended would, therefore, traverse a distance of 1,000 feet in 100 revolutions.

Now, one pound lifted 1,000 feet is equal to 1,000 pounds lifted one foot, and the weights used on the dynamometer are numbered accordingly.

Following out the operation of the machine, we will suppose that twelve pounds are held up on the scale-beam, and that the counter shows a speed of 100 revolutions in six seconds, a worm and gear being arranged so as to ring a gong-bell at every 100 revolutions of the shafts.



BALANCE DYNAMOMETER.

The twelve pounds, which are called 12,000 pounds, are then divided by the number of seconds consumed in the 100 revolutions, and the result is $\frac{12000}{6}=2{,}000$ pounds lifted one foot in a second, which result being divided again by 550, the equivalent expression for a horse-power in feet per second, gives 3.636-horse power as the load passing through the machine.

The operation of the dynamometer is this: On the receiving shaft, in the present arrangement, are fixed a pair of fast and loose pulleys at one end, and a spur gear at the other. This spur gear drives a corresponding gear of the same size and number of teeth, which is fixed on the end of a sleeve or collar, having on its other end a bevel gear, which forms one side of what is known as a "box" or "compound" gear. A corresponding gear on the opposite side of the "box" is fixed on the delivering shaft, which passes through the sleeve above mentioned, and also through the fulcrum of the scale-beam. The two remaining sides of the "box" are composed of a pair of equal and similar gears, which revolve freely around the scale-beam on either side of the fulcrum. One would really be sufficient for the purpose, but a pair is used in order to preserve a balance.

When motion is given to the shafts by means of a belt to the receiving pulley, the intermediate gears revolve about the scale-beam without effect; but when a belt is carried from the delivering pulley to the machine to be tested, the resistance causes the intermediates to act with the effect of levers on the scale-beam, and would put the latter in revolution about its axis or fulcrum, if it were not restrained by the weights, which are to be added and adjusted until a balance has been obtained.

It will be readily seen that the real motion of the scale-beam, were it free to move, would only be one-half that of the shafts, and the weights in actual use are, therefore, double their apparent value, or, in other words, the weight marked 1,000 pounds is, in reality, two pounds instead of one.

The dash-pot, or hydraulic regulator, is a cylinder filled with water or oil, in which a piston traverses with moderate freedom, and which is attached to the other end of the scale beam, in order to check vibrations and insure steadiness.

In the first machine built for James B Francis, and in several others either copied directly from it or slightly varied, the two shafts were upon the same horizontal plane, and increased the length of the floor space required, so that in many cases it was difficult to place the ordinary dynamometer in the ordinary alleys or floor space left between the machines in the cotton or woolen mills or machine shops.

This difficulty is obviated in the form of construction adopted in the drawings by placing the shafts vertically, one above the other, and space is also economized farther by making the frame of iron instead of wood.

The diameter of the dash-pot, or hydraulic regulator, is increased so as to obtain a more perfect resistance to vibratory or irregular motion, while the piston has sufficient clearance to move freely through the oil, which is used as a resisting fluid, at a slow velocity.

The bevel gears are of cast steel. The central boss or fulcrum of the scale beam, around which the intermediate gears revolve, and through which the shaft passes, is of phosphor bronze, to ensure the necessary strength with the least friction.

A pair of pulleys is provided for each shaft, the inner one of each pair being keyed fast to the shaft, while the outer ones are fitted with set screws, having proper seats sunk in the shafts, so that they can be locked, so as to make while driving one wide pulley, or by releasing the set screw they can be made into a pair of fast and loose pulleys for the receiving shaft, according to the direction from which the belt is delivered, whether from above or below.

The gear teeth have been made of ample strength to resist the pressure of all the weights furnished with the instrument, if the whole strain were applied to one tooth, and as they are so cut that three teeth will always be in contact at the same time, the factor of safety is amply sufficient, and the power which can be weighed, by the use of all the weights, is equal to one-horse power for every hundred revolutions of the shafts, or to all the power which can be relied upon to be transmitted with safety by a single belt of 2½, or even 3" wide, although the pulleys are intended in the machine which we have built for a belt of 2½".

The scale beams are made detachable for convenience in packing and transportation, and a "guide-wire," or "sight-rod," is added, fitting into a socket in the frame, and standing, when level, parallel with the steelyard, by which the operator can easily see when he has attained his balance.

The floor space occupied by this instrument is 30"x24", and its weight, for the machine alone is 284 pounds, the weights for use, which accompany it, being seventy pounds in addition.

Any form of dynamometer depending on springs, actuated by centrifugal forces or otherwise, must in time become inaccurate, if not so when first constructed. The form described is thought to be the true one; and since it embodies the principle of a known weight actually lifted through a known space, it must be very accurate. As proof of this, it may be said that such a machine has been used for the past ten years, weighing over one hundred thousand H. P. in small amounts, and the totals in some cases aggregating 250 H. P. have agreed within a few per cent. with the results obtained from indicator cards taken from the engine driving the same machinery. In addition, numerous comparative tests, made with the Prony brake, all showed that the error, if any, was extremely small between the two, provided, of course, that the tests were accurately made and with proper apparatus for a Prony brake.

LETTERS FROM PRACTICAL MEN.

Comparison of Pumps and Injectors for Feeding Boilers.

Editor American Machinist:

In reference to a communication from F. B. Rice, in your issue of July 7th, entitled "Feed Pump *vs.* Injector," I am led to comment on the same, having had considerable experience in the use of both. I do not hesitate to say that generally speaking, in large manufacturing establishments, the pump referred to as being driven by the engine is not practicable, for various reasons. It is very often the case that a much larger proportion of boiler than engine capacity is required; and consequent upon this fact steam is as often acquired while the engine is not in motion. Perhaps as often the engine is located at an inconvenient distance from the boiler to be fed in the manner indicated; hence my impression is that it would be a more expen-

sive way of feeding boilers than with the injectors.

Certainly, the ordinary feed-pump is a much more expensive way of feeding.

It has been demonstrated by experiment that 2.608 lbs. of steam, of 66 lbs. pressure, is required for every 100 lbs. of feed-water forced into a boiler against a like pressure with a good feed-pump, *i.e.*, direct acting steam pump, while with the injector only 0.219 lbs. of steam are required to do the same work. This shows the steam pump to be about 11½ times more extravagant in its use of steam.

The injector can, of course, send its delivery water through an exhaust heater and obtain all the advantages of that method of heating; and if the boiler is sending its waste products of combustion into the chimney at from 400° to 500°, a further advantage can be gained at small expense by locating a coil of pipe in the flue where it leaves the boiler (so located as not to obstruct the draught), and the water, after leaving the exhaust heater, made to pass through this coil on its way to the boiler.

By this arrangement we are now feeding boilers at 230° Fahr.; this is the average for seven days in the week and fifty-two weeks in the year, the record being taken every two hours from a thermometer located in the feed-pipe just before entering the boilers. Is any one doing better? THOUGHT.

Planer Construction—Rotary Cutters.

Editor American Machinist:

Our friend, Oberlin Smith, touches the weak point in the common planing machine, but I fear the remedy he proposes will not wholly cure the disease. The plan looks all right, in the drawing, but owing to the impossibility of putting cross-girts from side to side of the planer, at the point where the housings are secured to the frame, the whole structure is weak. I refer, of course, to planers made with the usual spur gearing, which interferes with cross-girts.

Some years ago I had plans made of a machine, in which a different way of overcoming the defect was introduced. The cut shows the scheme, which, in planers up to three or four feet square, would give a large amount of additional stability. The side pieces being provided with seats for the tool-posts offer better facilities for using the machine for side planing than when the tool-post is secured to the housings direct, as the crosshead was designed with a vertical feed motion.

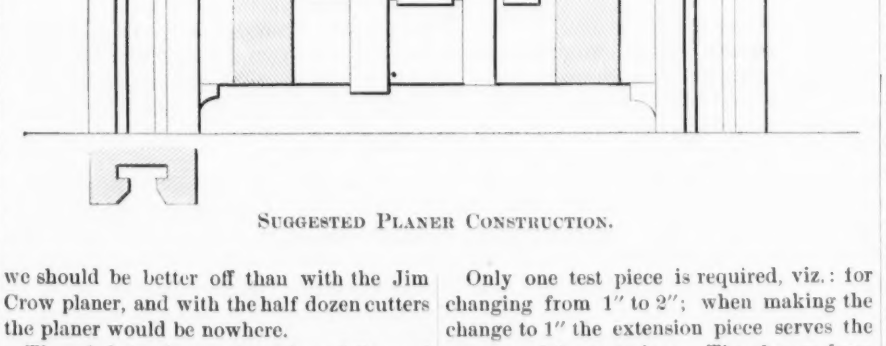
Another feature, embraced in the same design, was an arrangement for two speeds. The first shaft had two pinions of different diameters, and the second shaft two corresponding wheels to engage with them. The pinions were to be shifted by a hand lever, conveniently arranged, and the platen could be driven either slow or fast, at pleasure. By throwing the lever into a central notch, both gears were disengaged, and clutching in a cross-shaft, the crosshead could be raised or lowered by the same belts used for running the planer.

The arms on the crosshead have V projections fitted into corresponding grooves in the posts, a detached section of which is shown at lower left corner. By this means all the stability possessed by the crosshead is added to the side frames and crosstie at the top. A much deeper crosstie than the one shown at the top would be an improvement, and is employed by some builders.

Planing machines are likely to be built and used for a good many years to come, and there is a good deal of doubt as to their being as perfect as they might be for all kinds of work; in fact, I doubt if they ever will be as perfect as they ought to be, for I coincide with Mr. C. E. Lipe, in the belief that the milling machine is in its infancy, and that when the ponderous planer, which moves tons back and forth to nibble off pennyweight chips, is superseded, it will be by the rotary cutter.

There is a heap of sense in thus mounting a spindle over a planer bed rigged to run vertically and horizontally and given to run cutters from a half inch to two feet in diameter, traversing flat surfaces like a Daniell's planer, milling verticals and angles by tipping the head or by special cutters, cutting out slots on nearly all the work now done by the planer in less time, with better finish, and with an immensely less expenditure of power.

The point most likely to be raised against rotary cutters is the cost of making and maintaining them in the great variety that is likely to be required, but that need not necessarily be so, for if one is only content to do the special jobs at the present rate of planing, it may all be done with a single ended cutter. A single tool, something like a lathe tool set in the end of a spindle, will sweep off flat surfaces as fast as a tool of the same strength would do it in a planer. Waiting for the tool to come around on the back stroke would be no more than waiting for the planer to run back. With two tools we should be better off than with the Jim Crow planer, and with the half dozen cutters the planer would be nowhere.



SUGGESTED PLANER CONSTRUCTION.

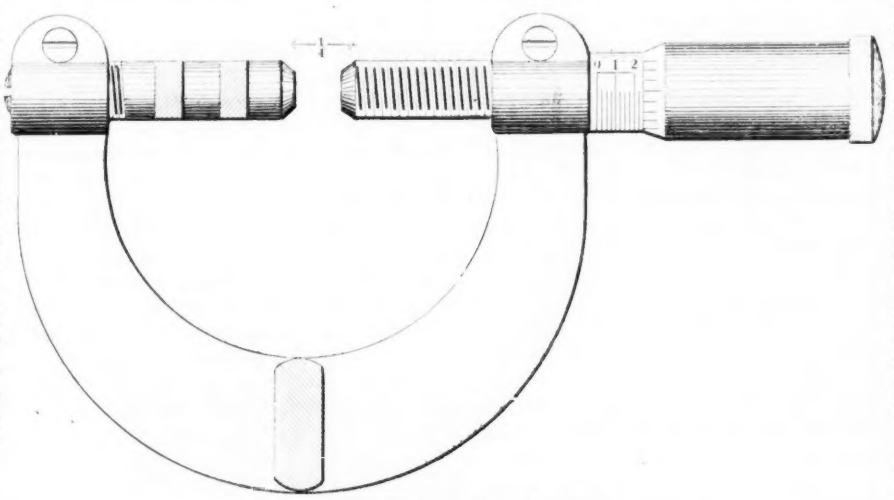
There is lots of room to make a failure of this thing or a good opening for success, and the man who succeeds will be the one who does not attempt to overdo the thing.

If with the new machine the principal work is done as well, even if a few things cannot be done at all, and others not as satisfactorily, still others can be done better, and occasionally a job can be done that cannot be done with the planer, and so the matter will be evened up. If there is only this one gain, viz., saving the power expended in the useless moving of heavy masses, the new machine will considerably discount the old one. JOHN E. SWEET.

Improvement in Micrometer Calipers.

Editor American Machinist:

In the micrometer caliper as at present constructed, the cost of two complete instruments for measuring up to two inches is more than many workmen are able or willing to submit to. I have recently altered



IMPROVED MICROMETER CALIPER.

over a two-inch instrument so as to serve the purposes of both a two inch and a one inch instrument. All that is necessary is to make the longer end-piece to be used in the place of the shorter one, when it is desirable to use the instrument for measuring less than one inch.

Only one test piece is required, viz.: for changing from 1″ to 2″; when making the change to 1″ the extension piece serves the purpose of the test piece. The change from one size to the other occupies only a short time.

Another feature I think should be adopted is the providing for tightening the nut on both screws instead of on the measuring screw only, as is now done. This would provide at any time for taking up wear, and consequent looseness of the end screw.

C. E. SIMONDS.

Luck Against Experience.

Editor American Machinist:

The extracts from Chordal's letters, June 9, brought to my mind so vividly some of the experience I have encountered myself, that I want to give you a short link in the history of a boy who started out for himself twelve years ago.

I started then with no knowledge of anything, and my wealth was about on par with my learning. I went down to the oil fields of Pennsylvania, and got a job running a small 10-horse power engine at an oil well. I knew just about as much about running an engine as I did about astronomy, for instance. I could truthfully say I knew the engine from the boiler, and that was about all I was sure of. Good luck helped me out, and I didn't blow myself nor anyone else up, and in that way I worked for about three years; then I began to think I was as good an engineer as there was. Of course I must be, for I had been there three years, and in all this time I had never seen the cover off the steam chest nor the head removed from the cylinder; never had lined a shaft or fitted a box, but still I was an engineer (and when I told it myself, I was a good one). If any man had wanted me to run a locomotive, I should have felt myself perfectly competent.

After I had been there some time longer, I had a chance to go to work in a machine shop. At that time there was no work done in the shop, except repairing engines and oil-well tools. The very first morning the boss came to me and asked me if I was used to running engines. I told him I was, most emphatically. He asked me if I thought I could fix one that was out of repair. I said I thought I could. So he told me to take what tools I wanted, and go over the hill to a certain well and set the eccentric for them. "*Set the eccentric; take what tools I wanted.*" If he had said, "Take a man with you," I should have felt relieved. It was too late to "take water;" so I picked up a hammer and a pair of gas tongs and three or four wrenches—about all the available tools in the shop. What I thought I was going to use the tongs for I have never found out. Well, when I got to the well, I found that the engine was one with a patent rotary valve under the cylinder—link motion. A man there, who knew as much as I did about engines, had steam up, and I tried to start the engine, but it wouldn't go. I reversed it, and still no go. When I reversed the motion, I couldn't make the steam blow from but one cylinder cock. We turned her over by hand two or three times, and still it was all the same. A stroke of inspiration induced me to disconnect the link from the valve stem and take off the cover of the steam-chest, and the valve stem was broken just inside the packing box, so I got out of that scrape and took the moral to heart.

ENGINEER.

Managing Men Easily.—"We" versus "I" in the Shop.—Receiving Suggestions from Workmen.

Editor American Machinist:

That employer is a happy man who has the faculty of keeping his shop well supplied with the right kind of workmen; men who seem to fit into their places as if they had grown up in them, and who will stand by the old shop and its interests with the pride of a good soldier; men who think of and work in accord with the general system as if they were all—employers and employes—a happy family.

There are such men among employers to-day—men who go along in such a quiet every-day sort of way that things seem to take the right shape without any special management. Such a manager realizes the fact that it is not the amount of mental or physical labor that he can do unaided that brings him success, but his efforts supplemented by the help that he can get from others. Men are the tools with which he works, and he is familiar with them and their circumstances, their aims and their capabilities, and he does not lose sight of the fact that men can be controlled to better effect by their ambition than by their fears.

He who enters his shop does not "leave

hope behind him." If censure is sometimes necessary, praise is not withheld when it is merited. With him the "we" is of more frequent use than the great "I." This may seem to be a very small thing to notice, but workmen do observe just such things, and the "we" identifies them with the interests of the shop. If anyone doubts the potency of this word, let him when there is a difficult job to be done give directions by saying, "We will do this job so and so," and he will see that the workmen will have more confidence and take more interest in the work, and when the work is done it is gratifying to them to have it acknowledged that "we" did it. A shop cannot be run successfully without the hearty co-operation of the workmen.

When I was quite a young journeyman, an older man and myself were set doing certain work on a boiler, which we both thought would render the boiler unsafe. We were talking it over, and I expressed my opinion in strong terms just loud enough and just in time to get a lesson on the propriety of a journeyman's minding his own business and doing as he was told to do. The next day that boiler exploded and killed the fireman, and the explosion was caused by the work that I had helped to do the day before.

Some 25 years ago, in an Eastern State, a large factory fell and killed about 80 people On the witness stand, before a coroner's jury, the man who had charge of the construction of the factory, admitted that at the laying of the foundation a workman had told him that they were not below the quicksand, but he further testified that he had long ago given up paying any attention to what a workman said.

On the other hand, workmen do not know it all, nor even the greater part that is to be known, and I have been justly snubbed for offering suggestions, and I have been provoked at having senseless suggestions offered.

I once knew a man to run a stationary engine, and the first day he made and submitted plans for turning the boiler end for end and moving the engine so as to have the fire-door and the throttle nearer together. They were about 25 feet apart. He was a man of some mechanical ability, and made a fair drawing, but he wanted to display his ability at once, instead of waiting until suitable opportunity offered.

The employer readily sees beneath the surface of such stratagems, but he should not let it destroy all confidence in what workmen say, and with the wise employer it does not do so. He avails himself of all the assistance he can get from his workmen, and cheerfully returns an equivalent, not in money alone, but in ways that tend to render workmen happy and contented.

F. J. MASTEN.

Proposed Method for Fastening Eccentrics—Tappets for Stamp Mills.

Editor American Machinist:

I submit a method of securing locomotive eccentrics to their shafts or axles. The eccentric fit is made slightly larger than the general diameter of the shaft, and a series of V grooves milled upon its surface in the direction of the length of the shaft, as shown at *A*, Fig 1., and at *B*, *B*, Fig. 2.

The V's ought to be cut to an angle near 60°, as being the most suitable, and enough of them side by side to cover a space equal to 3 or 4 times the width of the key. The key may be narrower than usual, say ⅓ the diameter of the shaft, and must have corresponding V's in the face that is in contact with the shaft.

At Fig. 3 is shown the key somewhat enlarged. It will be noticed that the sides of the key and key way are shown slightly narrower toward the center of the shaft. This insures the easy placing and removing of the key, and a good side fit when in its place.

It will also be noticed that the width of the key measures four V's, plus one-half of a V. This allows a movement of the eccentric upon the shaft of one-half the pitch of the V's, from its present position, by withdrawing the key and replacing end for end. (See dotted lines.)

This would be the least movement ever required to take up lost lead, etc. The key is held to its work by a tight-fitting, flat-pointed screw on its back, a corresponding cavity being made in the key to keep it in place.

The hole for the binding screw is bored through the rim, as shown at *D*, and tapped from the bore of the eccentric outward.

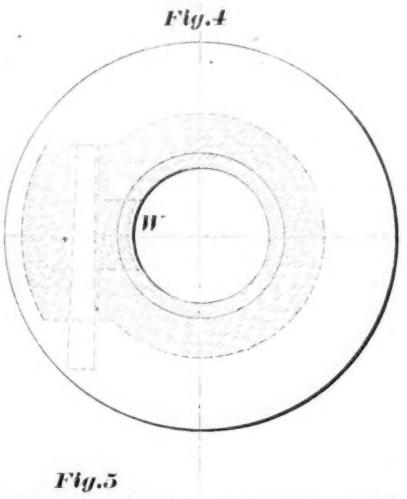


Fig. 4

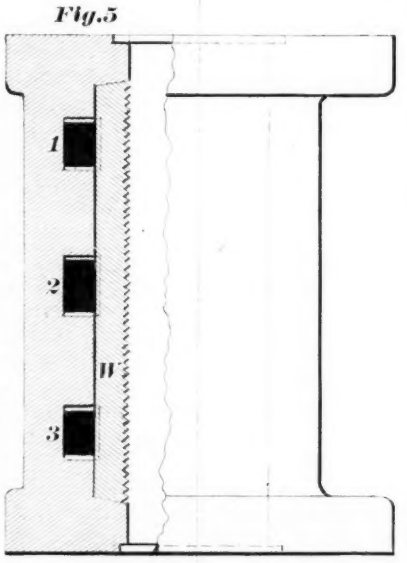


Fig. 5

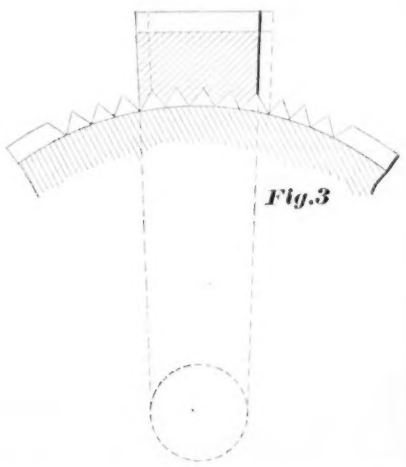


Fig. 3

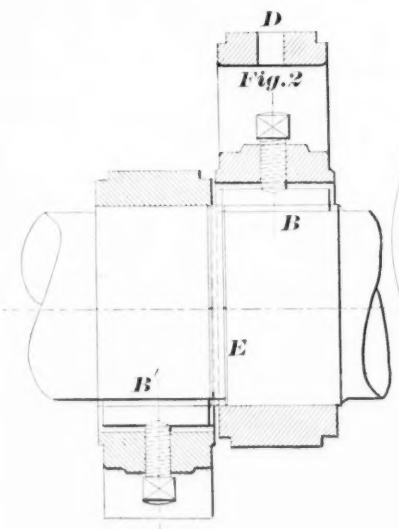


Fig. 2

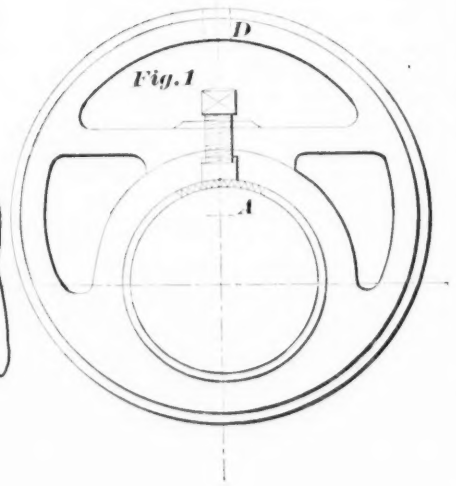


Fig. 1

The eccentrics are drawn to scale, and are shown unusually wide, but that will not be found fault with by those who have to deal with them. No hubs are shown, as it is believed the fit is wide enough. By being close together, little offset is required in the eccentric rods. A groove *E*, gives clearance to the tool, which is supposed to cut from right to left for the forward eccentric, and left to right for the backward. Care must be exercised to bring the main crank-pins into proper position relative to eccentrics before pressing on the driving wheels. The above is new to me, and might upon trial develop some unheard-of prank.

Not so of Figs 4 and 5, which represent the kind of tappets used in stamp mills, for raising the heavy stamps. A cam operates on the under side of each tappet to raise them, and they fall by their own weight. The concussion is so great that the tappets often slip on the stems, to which they are fastened by means of the keys 1, 2, and 3, acting against the gib *W*, which in turn presses against the stem. This gib is invariably made smooth, and not with V's, as shown.

After erecting a stamp mill I found the tappets slipping as usual, and having nothing better at hand, I put a large gas tap entirely through the bore of the tappet, and as I did not want grooves anywhere but on the gib, I used the same tappet for all the other gibs; the plan succeeded admirably.

JOHN A. CALDWELL.

Bay Ridge, Brooklyn, N. Y.

Tool Dressing.

Editor American Machinist:

Mr. Goodyear's article on "Tool Dressing, Hardening and Tempering," in your issue of July 7, prompts me to reply in the way of friendly criticism, hoping Mr. Goodyear will "get mad" and strike back, to the end that the readers of the AMERICAN MACHINIST, of whom I am one, may learn something. My excuse, if any is needed, is something like that of the Pennsylvania farmer for speaking on the hog-ringing question in the legislature—I was raised amongst steel.

It is related that at the completion of the Temple, King Solomon crowned the blacksmith the king of mechanics, but the modern machinist knows better than Solomon. When a boy has served two years in the blacksmith shop, or until it is plain to himself that he will never make a blacksmith, he goes into the machine shop for a year, then goes to the next town, and in a few years turns up as foreman of the machine and blacksmith shop, and dictates to the blacksmith how to dress and temper tools.

Who ever heard of a blacksmith being foreman of a machine shop?

Mr. Goodyear has a hard piece of steel that has resisted the efforts of the machinist to plane and the blacksmith to anneal. There is nothing remarkable about the machinist's part in the failures, especially when he dictates how his tools shall be dressed; but a piece of steel that cannot be annealed is valuable. It is evidence of a brand that we know nothing about.

Now, as a matter of *fact*, outside the *fancy* that it cannot be annealed, let us say that we have a piece of hard steel to be planed. Says Mr. Goodyear: "Let us instruct the tool-dresser how to make a tool to plane this piece. First, a good big fire, not too hot. Not too much blast, but just enough."

What would a machinist—Mr. Goodyear, for instance—say to this order: Make me a big bolt, not too long, not too big, but just big enough. Don't make too much head, but make just enough!

We want to know how to dress this tool, and we want to know how to build this fire. What weight of coal shall we use, and what should be the temperature of the fire?

"Heat the steel evenly, being careful to have no part at any time too hot."

Now I am at sea again. The part of this tool to be heated is, say, 2½" long, 1¼" wide, and ⅜" thick; and how to heat it evenly is worth knowing.

"Let the blows which are required to shape the blade of the tool be so delivered as to cause no more violent distortion of the metal than is necessary;" in other words, strike lightly. Now, in my opinion, Mr. Goodyear does not give the proper instructions for dressing a tool.

I am the tool dresser, let us say, and the foreman of the machine shop comes to me and says: "Joe, dress this tool for me. I have a piece of very hard steel"

"All right" I take the tool, stick it into any fire—under the boiler, into the heating furnace, or the stove—anywhere I can get the proper heat. The proper heat is as hot as it can be without burning the carbon. I then hammer it into shape with a smooth hammer on a smooth anvil, and if it is a cherry-red, as it should be, unless there is a good deal of dressing to be done to it, when I am through hammering, I stick the cutting point into the water up to about an inch, take it out and rub it with anything that will brighten it to show the temper, let the temper down to a light straw-color, and it is done—all at one heat.

Now for the reason for each operation: I don't care what the fire is like, because it is my business to see that the steel is heated properly. The reason why I take the highest heat possible is that I know no valid reason why I should not heat as high as the man who made the steel. He heats high to weld and close up the pipes, and that is one reason why I heat high; another one is that at a high heat it is more readily got into shape, and with less chance of injury.

I draw to a light straw-color because experience teaches that with a higher temper than this the edge of the tool will crumble. The reason why I only harden to a moderate height above the cutting edge is that when ½" is worn off the tool it is out of shape, and requires re-dressing; also the liability of hardened steel to fracture. I use a smooth anvil and hammer to avoid marks on the steel, which are liable to cause it to crack in hardening.

I have had different tool-dressers doing the work for the same machine shop, the cost of doing it varying from forty cents to two dollars a day. For those who worked cold steel the cost was the most. The best advice I can give a tool-dresser is, study the use and wear of tools if you want to please a mechanic.

JOSEPH H. GARTSIDE.

Foreman for McConway, Tourly & Co., Pittsburgh, Pa.

The *Mexican Financier* says:

"One of the greatest needs of Mexico at the present day is the establishment of works in various parts of the country, upon an extensive scale and with the most approved modern appliances, for the reduction of the precious minerals. There is no better opening afforded to American capitalists for good investment, with large and absolutely certain returns, than by meeting this demand. It is said that during the past two or three years, over $10,000,000 of American money have been invested in mines in this country. Many large mines, of course, have their own reduction-works; but these are of little benefit to mining at large, since they are generally kept busy in reducing their own ores, and have not the capacity to accommodate custom-work."

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NEW YORK, JULY 28, 1883.

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Accident to the Latest Cunard Steamship.

The steamship Aurania, a new vessel belonging to the Cunard line, met with a serious accident to her machinery last week, a few miles from Long Island, while on her first trip from Liverpool to New York. The vessel has just been built by a well known and trustworthy firm, J. & G. Thompson, of Glasgow, Scotland, this being the thirty-eighth ship they have launched for the Cunard line alone, and this is the first serious accident that has occurred to their machinery.

The vessel is of stupendous proportions, is magnificently equipped and elaborately finished, no expense or trouble having been spared to make the ship a floating palace. In extreme length the Aurania extends 483 feet, with a beam of 57 feet and depth of hold 37 feet, the tonnage measurement being upwards of 4,000.

To propel this immense body through the water there is a stand of engines that measure 1,500 nominal horse-power, and in ordinary service develop something over 8,000 actual horse-power. The engines are of the compound type that was pushed into popularity a few years ago by Elder and other eminent Scotch engineers, and which has done so much to enhance the economy of marine engines. These engines have the compound principle extended to its utmost limits, two low-pressure cylinders being supplied with steam from one high-pressure cylinder. The cylinders are vertical inverted—that is, all three cylinders stand in line above the main shaft, the piston-rod connections being made through the bottom of the cylinders, the three cranks being connected to the main shaft at an angle of 120°. The high pressure cylinder is 68″ diameter, and each of the low-pressure is 91″ diameter, the stroke for all the cylinders being 72″. To support these immense cylinders and all their connections at a point some 15 feet above the main shaft massive cast iron supports are used, part of which are utilized as the shells of the surface condensers. But over against each crank pit, running diagonally from the cylinder castings, are huge hollow pillars which are used solely for giving rigidity to the engines. The high-pressure cylinder is in the middle, and it exhausts steam from the top stroke into the forward low-pressure cylinder, and from the bottom stroke into the aft low-pressure cylinder, where in each case it is expanded down to 10 pounds before being educted into the condenser. Steam is distributed to the low-pressure cylinders by ported slide valves, and piston valves regulate admission and exhaust for the high-pressure cylinder.

The Stephenson link-motion is used for all the cylinders.

Each of the cylinders performs heavy work, but the immense pull falls upon the high-pressure piston where the steam presses with its initial vigor. The crank-pin, where the main rod from the high-pressure cylinder connects to the main shaft, is 23″ diameter, and the brasses are 26″ long. Connection between the crank-pin and the crosshead is made by a main rod of round steel 10 feet long and 11″ diameter. The breaking of this massive rod, when off the coast, disabled the engine and introduced sad havoc about the engine structure. It gave way during the upward stroke of the piston, about 3 feet below the crosshead, letting the piston smash its way through the upper head of the cylinder. Meanwhile the broken stub of the main rod swung round with the crank and hammered a hole in the supporting pillar which embraced that crank pit. The reversing gear was attached to this pillar, and it got demolished, besides several other portions of the machinery before the second engineer got round through the flying débris to shut off the steam. As the other cylinders were useless when their feeder, the high-pressure cylinder, was disabled, the vessel had to be towed into port.

The breaking of that tremendously heavy steel rod is a very curious case in the list of unusual marine accidents. Before the accident the engine had been working smoothly and satisfactorily, without jar or pound, so the strain on the rod should not have exceeded in a marked degree the pressure upon the piston, which was not more than 160 tons. Had there been a lost motion sufficient to double the strain on the rod, which is by no means likely, there ought still to have remained a wide margin of safety, which would leave a fear of breakage out of the question. The rod broke with a conchoidal fracture, and, from an inspection that was not so exhaustive as might have been desired, the metal did not seem to be homogeneous. It was evidently the case of a flaw amidst otherwise good material and unexceptionable workmanship. But for the existence of some defect in the rod its fracture would have been utterly impossible from any pressure the steam could have transmitted in ordinary working. A cylindrical rod of eleven inches diameter gives a cross-section of 95 square inches. Taking 48,000 pounds per square inch as a safe tensile strain for a steel rod, and that certainly provides a sufficient factor of safety, we have $48,000 \times 95 = 4,560,000$ pounds as a safe load for the rod, which broke from a strain which must have been under $\frac{1}{14}$ of this load.

There has been a good deal of nonsensical talk about sending the vessel to Glasgow under sail from lack of facilities here for repairing the damage. There are many engineering firms here that will gladly undertake the repairs, and will guarantee to execute them as promptly as any British shop. The most serious damage is to the high-pressure cylinder, which has the upper flange broken, besides bad fractures leading in to the upper steam ports. The probability is that the engines will be patched up to go home, when the maker, who has the patterns, will replace the broken parts. They may be fixed to cross the Atlantic with the low pressure cylinders taking the steam direct from the boiler without much labor. Should this be done the greatest amount of repairs needed will be on the reversing gear which was destroyed.

This ship, Aurania, exemplifies in a striking degree the rapid progress that steel is making in Britain as a building material. The whole shell of the vessel is of steel, and that metal is used in every instance where it is deemed strongest and most appropriate. Steam is generated in eight steel boilers, two being single-ended, while six are double-ended. They are fired by 42 of Fox's patent corrugated furnaces, and have 20,357 square feet of heating surface. The steam raised by these extensive facilities, is supplied at a tension of 90 pounds to the square inch, when it passes through two cylinders, where about 85 per cent. of its expansive energy is utilized. A surface condenser of 13,000 square feet then provides ample cooling medium to effect a nearly perfect vacuum.

The propeller has blades of manganese bronze, and along with the connecting shaft weighs 47 tons. The steering gear is the most perfect we have ever seen, and is worked by a Muir & Caldwell engine, but can be promptly connected to work by hand or by rudder chains. A small engine drives a dynamo-electric machine, which illuminates the vessel with electric lights,

The vessel is built to be ready for naval service in case of necessity. The engines and boilers are protected by a guard of spare coal bunkers, which can be kept filled with coal to act as a shield from shot. Eleven water-tight compartments divide the ship from keel to deck, two of which are reckoned sufficient to float the vessel, and every measure of safety and provision for health or convenience goes far in excess of admiralty requirements.

Several years ago Geo. W. Richardson and F. F. Hemenway carried on a series of experiments with heated jackets for locomotive cylinders. They ran a current of the hot gases from the smoke-box round the cylinders, obtaining a high degree of heat ranging from 400° to 600°. This was considerably better than a steam jacket, and it ought not only to have arrested condensation within the cylinder, but should have been the means of slightly superheating the working steam. But a curiosity about the result was that the experimenters could perceive no saving. They could not make the engine do its work with less coal, so far as they could calculate, so the thing was abandoned. Some years later certain engineers in Europe calculated that steam jacketing for the cylinders of locomotives would effect an important saving of fuel, and M. Mallett, a celebrated French engineer, adopted the idea and carried it into practice. The famous Webb compound locomotive was made after a design introduced into France by M. Mallett, and what is claimed as an important factor of economy about the engine is steam-heated jackets. The question now is, How effective would these engines be if they had the hot-air jackets?

Iowa City has got a system of water works which was first tried a few weeks ago, and the display of water spouted all over the town was made the excuse for a general holiday. Iowa City is the seat of the State University, and in that institution there were numerous students aspirants of honor in physical science. The professor recommended these youths to fortify themselves with practical lessons in hydrostatics on the day of the opening of the water works, by close observation of the proceedings. A favorite point of observation for the young solons was the pumping house, where the large engines were toiling over the labor of throwing water through half of the hydrants in town. Great excitement prevailed about the engine house. The engineer was hurrying round, watching pumps and cylinders, condensers and guides, now dropping a little oil, then directing the firemen, but scrambling to and fro patiently amidst the crowd of students and citizens The firemen were fuming and sweating over the labor of keeping up steam, while obese councilmen volunteered directions and advice. The boilers were equipped with two "Consolidated" pop safety valves, and in the midst of the turmoil these valves went off like a clap of thunder. A fireman jumped through a window, scattering sash and glass in every direction, and he was followed by three students, who could not get out of the door fast enough. A frantic rush was made through every door, and men tumbled over each other in their anxiety to get away from what was supposed to be a "busted" boiler. The engine-house is situated at the foot of a steep hill, but several fat public functionaries made unparalleled time up the ascent, the students keeping well abreast of the hoary runners. Several of the men who figured in that stampede have got very change-the-subject when boiler explosions are mentioned.

British railway practice continues to be quite chaotic on the matter of continuous brakes for passenger trains. Considering that the whole island is smaller than one of several of our States, and that one strong government rules the whole country, it might be supposed that systematic uniformity would be observed in a matter so essential to safe travel as a continuous brake. Such is not the case, however. For the last ten years the government has been using its very strongest moral suasion, mixed with threats of impending arbitrary laws, to induce connecting railways to agree upon some efficient automatic brake. But they have not agreed at all, and each railway uses the brake that its officers are most deeply interested in. This has a curiously confusing effect upon some portions of through travel. A locomotive hitches on to a train that is going through some three or four hundred miles, and half the coaches have brakes that the engine cannot connect to, and when the end of the division is reached another engine couples to the train that has a brake which suits none of the coaches. The chances of the brake on the locomotive agreeing with that attached to the majority of the coaches seems very slim. A recent run under conditions of this kind, which ended in a smash through want of brakes to control the train, brought out a vigorous protest from the government inspector, but the companies seem to care as little for his wrath as they do for the safety of travelers.

Experiments have been going on for a long time with the object of eliminating phosphorus from inferior iron ores by means of a basic lining in the converter. A company was lately formed in England to develop this process, and they recently made an experimental blow in one of their converters specially constructed for the work. The phosphorus contained in the iron of the first charge amounted to between three and four per cent., and after the blow was finished careful analysis of the steel produced resulted in the discovery that only about .02 per cent. of phosphorus was present. This gave as pure a steel as is produced from the best hematite ores. Should this new process prove cheap enough for ordinary work, it will effect as great a revolution in the iron trade as was produced by the Bessemer inventions.

Literary Notes.

A PRACTICAL TREATISE ON THE STRENGTH of Materials, including their Elasticity and Resistance to Impact. By Thomas Box. E. & F. N Spon, 16 Charing Cross, London, and 35 Murray street, New York.

A comprehensive work that should treat from a thoroughly practical standpoint this, to mechanics and engineers, most important subject, has always been needed; hence it may be conceded that the author could hardly have made a happier selection of a subject. In this book of 536 pages, more than 150 tables and 27 plates, Mr. Box considers the general subject of the strength of constructive materials under the various strains to which they are subjected in actual use as parts of structures and machines, showing the effect, from experiments, of the different manipulations to which they are liable in the course of preparation. This he does in such a way as to render the information valuable, not only to the professional man, who desires to get at facts with the least possible waste of time, but what is of greater importance, in such a way as to make it available to shopmen, engineers and others, who are not familiar with calculations involving the use of intricate formulas. Everything is brought to the condition of a "rule" and "practical application," and the addition of examples illustrating the use of the rules will prove of great benefit, as shortening the time required to understand them, and assisting those who are studying the subject on the basis of a limited education. While those who are looking for theory alone may better look elsewhere, the practical man, who is interested in the use of constructive materials, will not fail to find himself in sympathy with the author's methods, and will only wonder that so much could be so comprehensively treated in the space.

Questions & Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

(248) J. D., Montreal, Canada, asks questions respecting the practice of makers of taps, for answers to which we refer him to the makers.

(249) C. L., South Bend, Ind., asks: How are clover huller cylinders balanced, and which is the most reliable, a running or a standing balance? *A.*—We do not know the practice in balancing the cylinders referred to. A running balance is the best for all except bodies of almost absolute rigidity.

(250) Apprentice, Philadelphia, Pa., writes: There is a discussion here as to the proper name of the side of a square file that is ground smooth. One party to the discussion calls it the safe side and the other the blank side. Which is right? *A.*—Both are right, as both expressions convey a meaning not likely to be misunderstood. It is not policy to quarrel with designations when they convey unequivocal meanings.

(251) J. O., New York, writes: In the AMERICAN MACHINIST of July 7 appears a communication from F. B. Price, in which he defends the use of the pump as a boiler feeder. If, as Mr. Price asserts, there is economy in using a pump under the circumstances referred to by him, what would be the result of putting in another heater, and using the exhaust as it comes from Hussey's super heater, as recently illustrated in the AMERICAN MACHINIST, at a temperature of 460°? *A.*—The question of a pump or injector hardly seems to apply to the case. The effect of using a heater as described would be to further heat the feed water, the result being an increased economy. So far as this economy, beyond the first heater is concerned, it would be immaterial whether the feeding was done by a pump or injector.

(252) F. B., Jersey City, N. J., asks: If I carry 40 lbs. boiler pressure, using the steam in a compound engine, the high-pressure cylinder of which is 21x36", what will be the pressure in the low-pressure cylinder, which is 42x36"? *A.*—Your question cannot, from the data given, be answered even approximately. The pressure in the low-pressure cylinder would depend upon how much of the 40 lbs. pressure you actually realize in the high-pressure cylinder, at what point the steam is cut off in that cylinder, what the pressure is at cut-off, what the loss between the cylinders is, and other considerations. The only reliable way to find what the pressure is in either cylinder is to use an indicator.

(253) C. B., Lexington, Ill., writes: I have a small screw plate, accompanying which is a table giving the sizes of wire corresponding to the number by gauge, as follows:

5/64	INCH	CORRESPONDS	TO	NO.	2	WIRE.
3/32	"	"	"	"	3	"
7/64	"	"	"	"	4	"
1/8	"	"	"	"	5	"
9/64	"	"	"	"	6	"
5/32	"	"	"	"	8	"
11/64	"	"	"	"	9	"

I do not find wire to correspond to these sizes. Can you tell me the trouble? *A.*—It is possible there is a wire gauge that will correspond with the number and sizes as quoted by you, but we do not know of one. There are a great variety of wire gauges, each differing from the others, and their use has become a positive nuisance.

(254) H. F., Brooklyn, N. Y., asks: 1. To what temperature can water be heated in a feed water heater, the openings through which are larger in area than the area of the exhaust pipe? *A.*—The water cannot be heated to a higher temperature than that of the exhaust steam in the heater—practically not to quite so high a temperature. If there is no pressure above the atmosphere in the heater the temperature of the steam will be about 212°, and if there is abundance of heating surface the feed water may be heated to about 210°. Even if the feed water entered the heater at a higher temperature than 212° it would be cooled by the exhaust steam to about that temperature. 2. If live steam is used in the heater so as to cause back pressure on the engine, can water be heated higher than this? *A.*—If the pressure in the heater is increased by any means, as either by admitting live steam or by choking the exhaust outlet beyond the heater, water may be heated hotter than 212°. For instance, if the pressure is increased to say 10 lbs. gauge pressure in the heater the temperature will be correspondingly increased, and water could be heated higher. If live steam were simply allowed to pass through the heater without increasing the pressure, water could not be heated beyond about 212°.

Business Specials.

Transient Advertisements, 50 cts. a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N.J.

Steel Name Stamps, &c. J B. Roney, Lynn, Mass.

James W. See, Consulting Engineer, Hamilton, O.

A. Wilkinson, expert steam engineer, Manayunk, Philadelphia, Pa.

Chas. T. Porter, Mechanical Engineer, Tribune Building, (Room 42,) New York City.

Patents.—Franck D. Johns, Att'y at Law & Solicitor of Patents, 617 Seventh St., Washington, D. C.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

For sale, 25" lathes of best designs from new patterns. George A. Ohl & Co., E. Newark, N. J.

Lyman's Gear Chart. How to lay out gear teeth. Price 50 cents. E. Lyman, C. E., New Haven, Conn.

Latest and best books on Steam Engineering. Send stamp for Catalogue. F. Keppy, Bridgeport, Ct.

Consulting Engineer and Mechanical expert, C. C. Hill, 144 LaSalle street, Chicago, Ill.

Wood Engraving done in best manner. Designs furnished. Edward Sears, 48 Beekman St. New York

Foot Power Machinery, for workshop use, sent on trial if desired. W.F. & John Barnes, Rockford, Ill.

Pattern and Brand Letters. Vanderburgh, Wells & Co., corner Fulton and Dutch streets, New York.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

How to reach 40,000 prominent "*Steam Users*" in the United States. Send for our circular. The J. N. Mills Publishing Co., 145 Broadway, N. Y.

Castings furnished for 18" and 21" swing engine lathes. Gearing turned and cut if desired. C. F. Batt, Phœnixville, Pa.

Currier & Snyder, Worcester, Mass., manufacturers of improved labor-saving upright drills, 24" and 26". A specialty circular and price on application.

Speed and drill lathes, 10"x4', new design. Self-clamping rest, first-class material and work. Parties about to buy will do well to inquire. C. Wing, Greenfield, Mass.

"Patent Binder" for the AMERICAN MACHINIST holds 52 weekly issues in good shape. Sent to any address by mail for one dollar. American Machinist Publishing Co., 96 Fulton street, New York.

The Complete Practical Machinist, $2 50; the Pattern Maker's Assistant, $2.50; Mechanical Drawing Self-taught, $4 00; books for practical machinists. Address, Joshua Rose, Box 3,306, New York City.

Business men furnished stenographers, who are machine operators, without charge for my services. Shorthand taught by mail. Caligraphs sold; special inducements offered; correspondence solicited. W. G. Chaffee, Oswego, N. Y.

Cheapest, strongest, most simple, compact, durable, effective and economical steam pump in the market. See list of prices in this column next issue. No machinery, no oil, no special care. Can be worked suspended by a chain. Pulsometer Steam Pump Co., 83 John street, New York.

The National Feed-Water Heater—the best and cheapest in the market; warranted to heat water by exhaust steam up to 206° to 212° Fahrenheit. This heater commends itself to every practical man. For description and prices, apply to the National Pipe-Bending Company, New Haven, Ct.

We will pay 25 cents each for copies of the issue of January 21, 1882, that are in good condition. Those kind enough to forward us copies of the above date will please write name and address on the wrapper for identification. AM. MACHINIST Publishing Company, 96 Fulton Street, N. Y. City.

Wanted—Correspondence with engine builders, boiler makers, and supply dealers in steam goods. We manufacture the *cheapest* Injectors and best Steam Jet Pumps in this country, and offer to *live men* the most liberal terms ever named. Drop postal for particulars to J. B. Sheriff, Son & Co., 68 Water St., Pittsburg, Pa.

Chordal's Letters.—John Wiley & Sons, 15 Astor Place, New York, have now ready a new and enlarged edition, with six additional plates, of Chordal's Letters, comprising the choicest selections from the series of articles entitled "Extracts from Chordal's Letters," which have appeared in the columns of the AMERICAN MACHINIST; with a steel portrait of the author, and upwards of fifty original illustrations by Chas. J. Taylor. One volume 12 mo. of nearly 400 pages, cloth, $2.00. Will be mailed and prepaid on the receipt of the price.

Manufactures.

Cotton mills are to be built at St. Martinsville, Miss, the capital stock being $100,000.

The Pullman Palace Car Company propose the erection of a branch manufactory at San Francisco, Cal.

The Wetherill Steel Casting Company, with a capital stock of $500,000, has been chartered at South Chester, Pa.

Shaw & Lambert, formerly of Brockton, are to build engine lathes and upright drills at Bridgewater, Mass.

The Hopedale (Mass.) Machine Company have lately made a considerable shipment of cotton machinery to Mexico.

A stock company with a capital of $100,000 propose to manufacture the Miller printing press at Woonsocket, R. I.

Philadelphia parties have bought the large sewing machine factory at Downington, Pa., and will use it in the manufacture of stoves.

A new stove foundry is about to be started in Chattanooga, Tenn., with W. W. Baldwin, of Cleveland, O., as President.

Capital to the extent of $10,000 has been raised for the purpose of starting a cotton seed oil mill at Elberton, Ga.

It is expected that the Youngstown (Ohio) Car Company will soon commence the construction of extensive additions to their works.

Smith, Meyers & Schnier, machinists of Cincinnati Ohio, propose to increase their capacity by the erection of a new building 240x60 feet.

The Morris County Machine and Iron Company, Dover, N. J., have issued a new illustrated catalogue of their new high-speed air compressor.

The Harvey Screw and Bolt Company is to erect extensive buildings at Lime Rock, Conn., during the present year.

The United States Rolling Stock Company is to erect extensive and durable car shops at the forks of the Calumet River in Hyde Park, near Chicago, Ill.

The Missouri Malleable Iron Company at St. Louis are putting in new furnaces and machinery and erecting additional buildings by which their output will be more than doubled.

An effort is being made to have the machine shops of the Alabama, Great Southern, the Vicksburgh and Meridian and the N. O. and Northern Railroads located at Meridian, Miss.

We learn from Mr. Wootten, of the Philadelphia and Reading Railroad, in a personal letter, that his company are doing nothing further in the way of shop extension this season than adding small buildings where they are most urgently required.

The Curtis Regulator Company writes us: "The Merimac Manufacturing Company have recently put in a 5" Curtis pressure regulator on their steam pump. This pump throws a 10" stream and feeds 7,000-horse power of boilers."

Manning, Maxwell & Moore, 111 Liberty street, New York, were awarded the medal for the best tube-welding machine at the Chicago Exposition of Railway Appliances. This machine was illustrated in the AMERICAN MACHINIST of June 30.

U. S. Consul E. G. Van Riper, Moscow, Russia, and Alexander Schnee, have formed a copartnership under the style of E. G. Van Riper & Schnee to conduct business at that place as Russian-American commission merchants for import and export.

The Otis Iron and Steel Company of Cleveland exhibited at Chicago, among a great variety of products, steel plates, one of which was 56x626" and another 72x372". These plates, although of such immense size, were said to be remarkably true to gauge.

The Keokuk (Iowa) Plow Works have begun the erection of shops to have a total frontage of 450 feet. They will consist of a foundry, 40x100 feet; blacksmith and machine shop, 40x100 feet; wood and paint shop, 40x120 feet; polishing room, 30x50 feet; engine and boiler room, 40x50 feet.

The Northwestern Steel Wheel Company has recently been incorporated, and are at once to erect works at Chicago, Ill. Their purpose is to manufacture a newly patented steel wheel for agricultural machinery. Their works will consist of a machine shop and foundry.

The St. Louis *Age of Steel* says the Rohan Bros Boiler Manufacturing Company are now working 170 hands and would take more if they could get them. Their works are literally jammed full of work, and orders are piling up on their desks faster than they can dispose of them.

The New York, West Shore and Buffalo Railroad Company has just ordered thirty new sets of Swift's lubricator cups for their locomotives. One engine has had the lubricator for several months, and it has given so much satisfaction that they wish to prove its merits on a larger scale.

The Baltimore (Md.) *Manufacturers' Record* says it is authorized by several capitalists to say that they are prepared to invest money in the manufacture in that city of any line of hardware that can be made at a profit, the only requisite being that any party desiring their co-operation must prove his ability to manage the establishment.

The Consolidated Safety-Valve Company, 111 Liberty street, New York, have received an order from the Croton Flour Mills, Hecker & Co., recently rebuilt, for 4" nickel seated pop safety-valves for all their boilers. These safety-valves took the medal for "best locomotive pop safety-valve" at Chicago.

The Chesapeake, Ohio and Southwestern Railroad Company has purchased fifty acres of land in Paducah, Ky., and will immediately erect thereon machine and boiler shops, and an engine-house with 25 stalls, and will, within a year, give employment to 2,000 men. The city subscribed $20,000 to secure the location of the shops.—*Railway Age.*

The Ashcroft Manufacturing Company, Boston and New York, received a silver medal at the Chicago Exposition for the best steam engine indicator—the "Tabor," also for the best locomotive steam gauge. We are informed that Prof. Thurston, of the Stevens Institute of Technology, has ordered a pair of these indicators with a complete set of springs for use in expert tests.

John J. Grant, of Grant & Bogert, Flushing, N.Y. returned home July 6 from a 23 days' trip to the West, having taken orders for five engine lathes, a special tube-straightening machine (the latter from the Brush Electric Company of Cleveland, O.), one very large milling machine, weighing 12 tons, from a Western railroad, and a cutting-off lathe, besides having a large number of other orders in prospect. He reports an improved tone in business, with prospects of a good fall trade.

The location of the Aurora Watch Factory which has been a vexed question among certain property-owners for some time, has been settled in favor of South LaSalle street, on the east side. The liberal tactics of Senator Evans won the victory, as usual. He offered fourteen lots of the old Norris property, and the company has accepted his offer. Work upon the main building will begin about the 1st of September. It will be 185 feet long, with wings 4-stories high and a center part of 6 stories.—*Chicago Journal of Commerce.*

The *Industrial World* says the Fowler Rolling Mill Company, Chicago, have recently doubled their capacity for the manufacture of the Fowler spike by the placing in of an additional train of rolls, a 100-horse power engine and boiler and additional furnaces. By some improvements lately made by Mr. Fowler he is enabled to carry an old rail from the furnace and convert it into finished spikes in 14 seconds. By this process the usual reheating of the iron is obviated. The company have just purchased the remainder of the block adjoining their works, which will give them the necessary enlargement of their plant.

The *Commercial Bulletin* says work at the Hampden Watch Works, Springfield, Mass., is pressing. Orders are down for several months' work, and the 400 operatives are working all day, and some of them by night, to catch up, while the managers are constantly planning improvements and preparing to increase their capacity for work. Two new boilers have already been put in, and a new engine is expected soon. To one end of the new factory building is to be added another building of the same size, which will make a factory 240 feet long, 30 feet wide and 3 stories high, and at the middle point will stand a tower 60 feet square and 4 stories high. The company expect to double their number of employes soon, and to make it 1,200 when their factory is completed.

Machinists' Supplies and Iron.

NEW YORK, July 12, 1883.

The general supply business has not materially changed during the week, although in some instances there is evidence of improvement. It is not to be expected that there will be much change during the hot months. Manufacturers are fairly busy for the time of year, and manufacturers and dealers are hopeful of a reasonably good fall trade.

Cooke & Co, 22 Cortlandt street, New York, have issued a new illustrated catalogue of 460 pages, also a price-list of 188 pages.

The Holmes Gear Works, Gardiner, Me., have published an enlarged edition of their pattern list, which embraces a very complete list of gear wheels and mill supplies, as well as several useful tables for engineers and millwrights.

In iron the price for American pig rules firm at the recent advance. The supply in the hands of users is small, which necessitates buying for summer use, at the same time it does not seem to be anticipated that prices will rule higher, nor on the other hand a decline is not thought probable. The result is that while buyers are not inclined to place large orders, they are buying with rather more freedom than a few weeks ago.

We quote No. 1 X Foundry (standard brand) at $22 to $22 50, with choice lots at $23. There is but little demand for No 2 X Foundry, and as a consequence prices are comparatively lower than for No. 1, quotations being from $19 to $20. In Scotch Pig limited sales are made of Coltness, $23.50 to $24; Glengarnock, $22 50 to $23; Gartsherrie, $24 and Eglinton, $21 to $21.50.

Recent advances in freight are having a tendency to slightly advance the price for future delivery of Scotch brands.

The demand for steel rails is quiet, with sales in small lots at mills for $37.50 to $38. There is no business in old rails, asking prices being higher than will be conceded by buyers.

Spelter is in moderate demand, with prices for refined at 8c. to 8¾c; Silesian at 5c. to 5⅛c. Tin for jobbing lots—Banca, 22c.; Straits and Malacca, 21¼c. to 21⅜c. Antimony—Hallett's, 9¼c.; Cookson's, 10¼c., with moderate demand.

In copper, Lake is selling at 15½c. to 15¼c.; other brands, 14c. to 14⅛c. Lead, 4.35c. to 4.40c.

WANTED

"Situation and Help" Advertisements, 30 cents for each seven words (one line) each insertion. Copy should be sent to reach us not later than Thursday morning for the ensuing week's issue

Wanted, Tool Maker—A good workman can find permanent employment. Joel Hayden Brass Company, Lorain, O.

Wanted—First-class pattern maker; to a good man steady work and good pay. Write B. W. Payne & Sons, Corning, N. Y.

Wanted—situation by a first-class practical "iron foundry foreman." Has large experience in all kinds of machinery, and the general management of men. References. Address, A. R., 735 River st., Dayton, Ohio.

Wanted—By an old and well-established machine shop in Southern Pennsylvania a first-class mechanical engineer and draughtsman who has had long practical experience in designing and building automatic cut-off engines, steam boilers and portable engines of various kinds, also other machinery; must be a good designer generally, and furnish the best of references both as to character and efficiency. Address Box 9, care AM. MACHINIST, 96 Fulton street, New York.

Wanted—A No. 2 second-hand Root Blower. Tozer & Dial, Columbia, S. C.

Light and fine interchangeable machinery to order. Foot and power lathes; slide rests, &c. Catalogue for stamp. Edwd O. Chase, Newark, N. J.

Wood patterns for foundry and machine shop crane; cost $1.000 to $1,200; will exchange for second-hand screw-cutting engine lathe 6 or 8 foot bed. Address Garbutt Foundry, Garbutt, N. Y.

Wanted—An iron and brass moulder as partner, with $5.000, to start a foundry with my machine shop in Galveston, Tex.; have been in business 20 years; the present is a very good prospect. For further particulars write to Jesse Astall, Galveston, Tex.

Wanted—Young men wishing to learn the machinists' trades or to take a special or full course in machine work, pattern making, tool forging, tool making and tempering and mechanical drawing. Address or call on School of Mechanical Instruction, No. 195 Front st., Worcester, Mass.

JOSIAH MACY'S SONS,
189 & 191 Front Street, New York,
MANUFACTURERS OF
LUBRICATING OILS,
Lard, Sperm, Whale and the
"UNICORN,"
Brands of all gravities, suitable for all grades of work; light, heavy, slow and high speed.
Samples Submitted Free. ESTABLISHED 1822.

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HARTFORD CONN. U.S.A.
All Sizes, Independent, 4-Jaw Combination Universal Geared and Lever. Brass Finishers' 3-Jaw, from 4 in. to 9 in. Chucks for Cutting-off Lathes, Screw Machines, and Amateur Lathes. Centering and Drill Chucks.
SEND FOR CATALOGUE.

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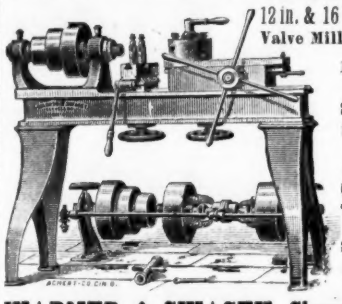
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Valve Milling Mach's
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WARNER & SWASEY, Cleveland, O.

COOKE & CO., DEALERS IN
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22 CORTLANDT ST., NEW YORK.
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The Waters
Perfect Governor.
Having Adjustable Speed, Automatic Safety Stop, Sawyer's Lever, and Solid Composition Valves and Seats. Also
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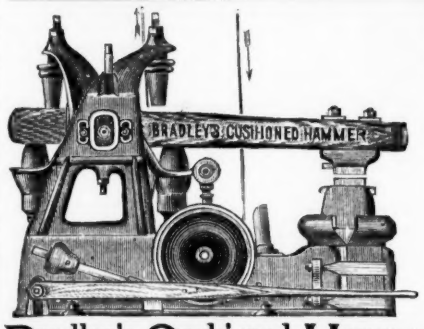

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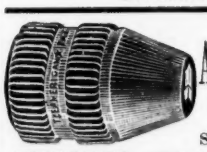
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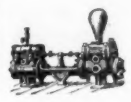
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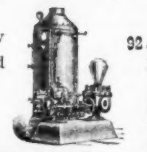
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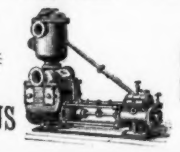
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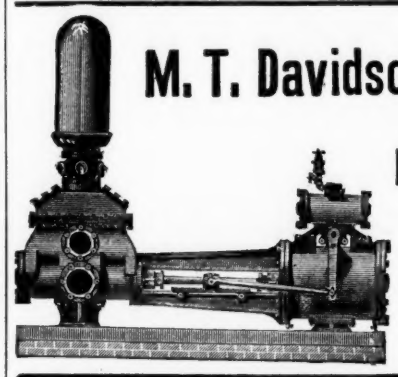
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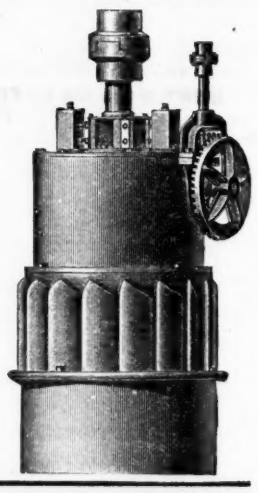
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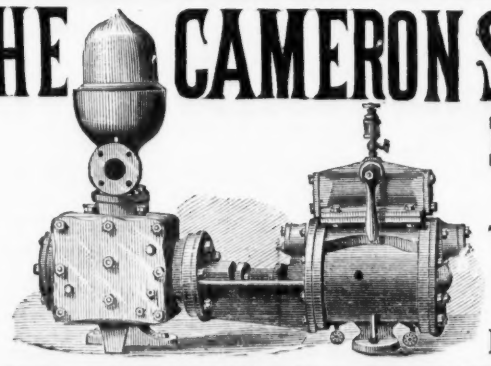
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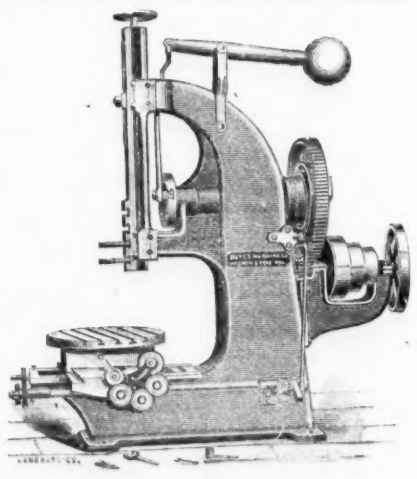

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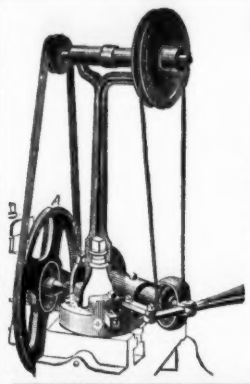

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This dog is very heavy, and is warranted not to break with any work

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Full set, 19 Dogs, 26.35

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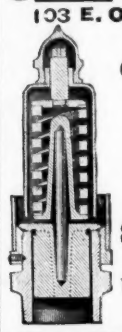

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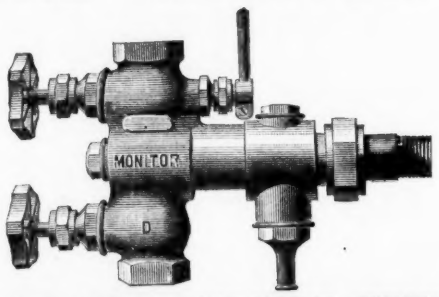

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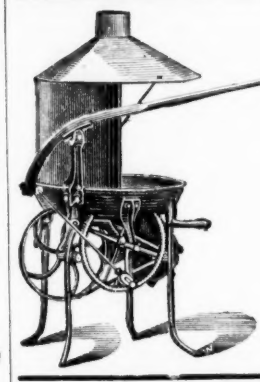

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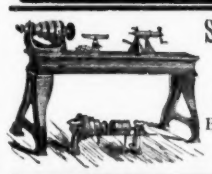

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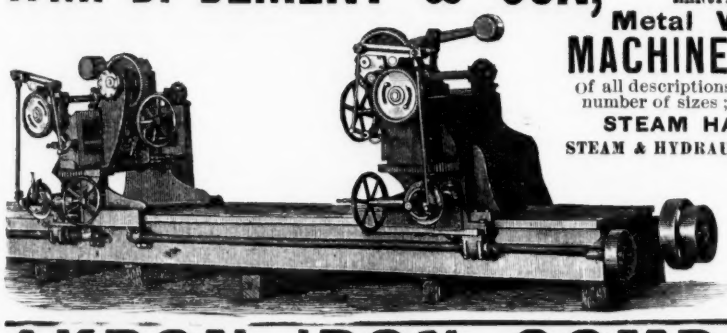

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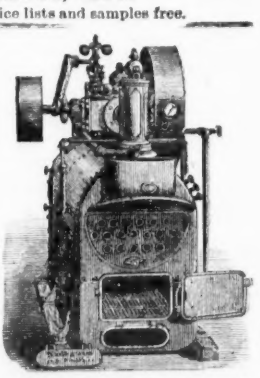

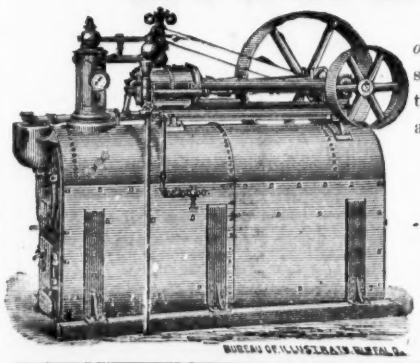

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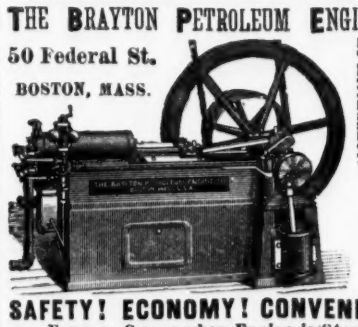

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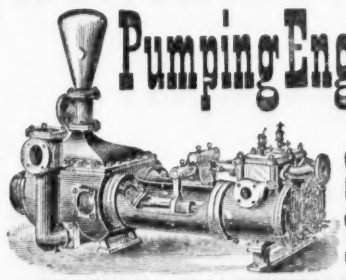

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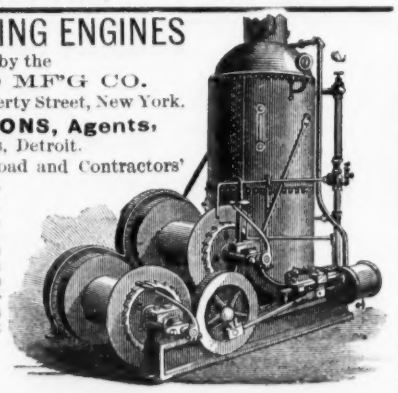

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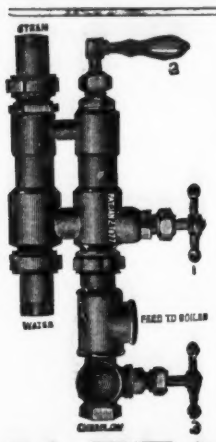

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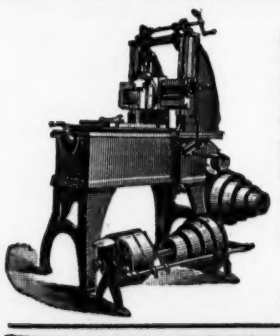

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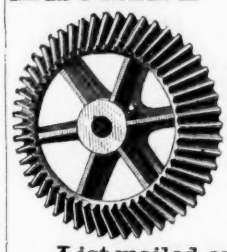

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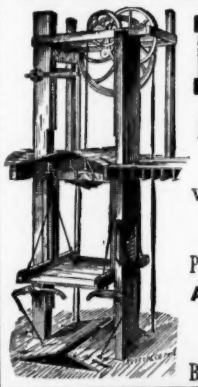

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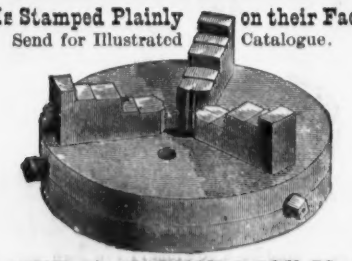

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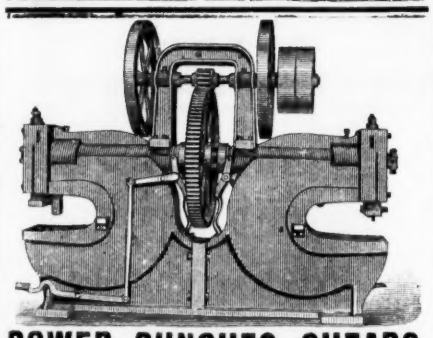

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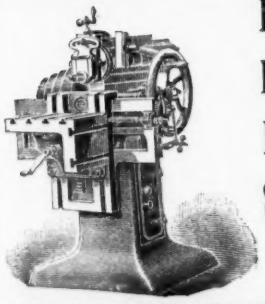

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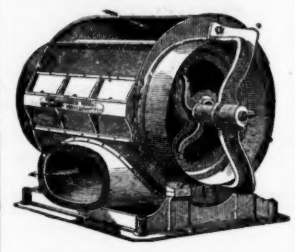

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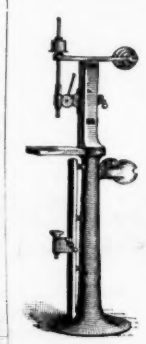

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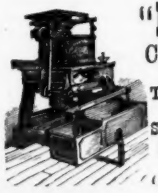

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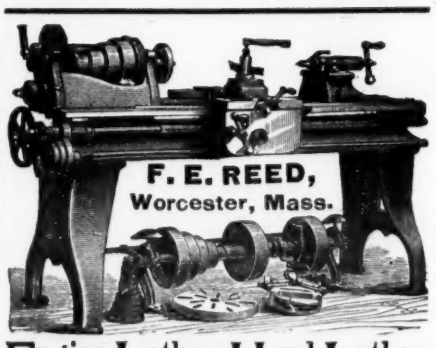

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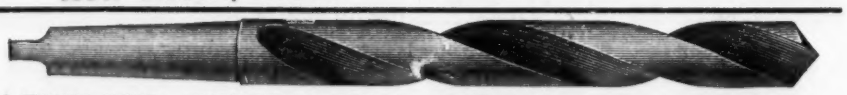

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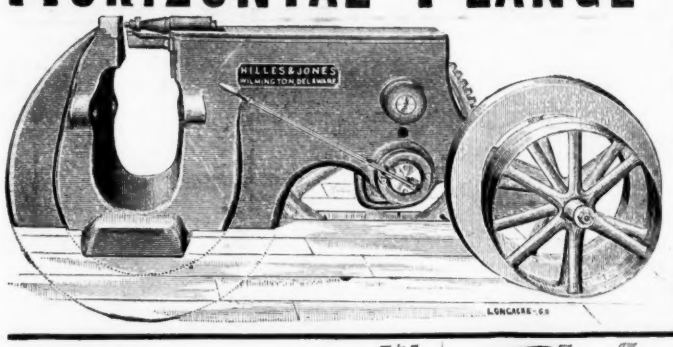

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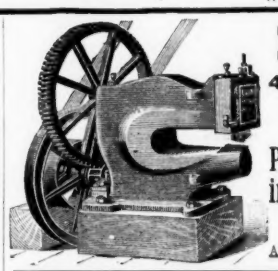

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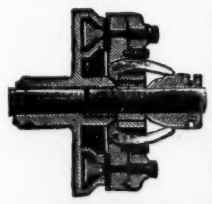

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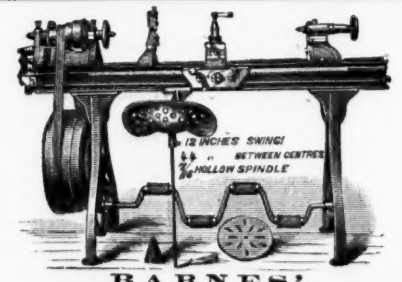

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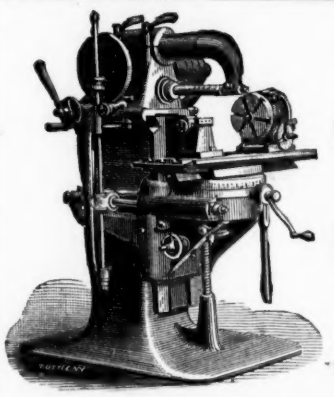

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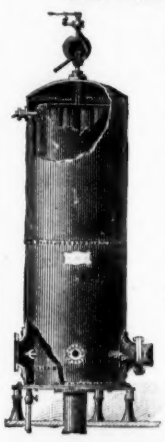

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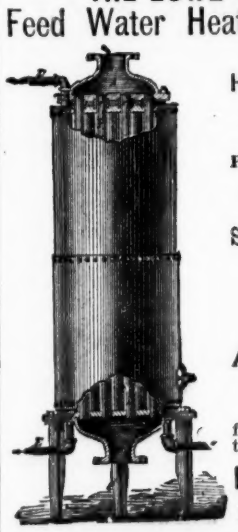

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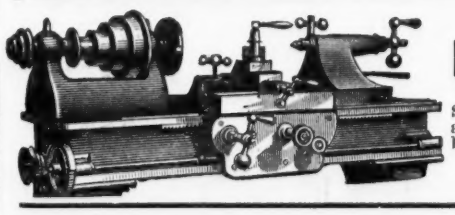

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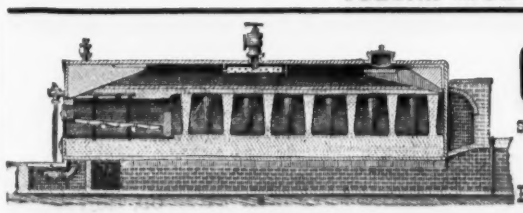

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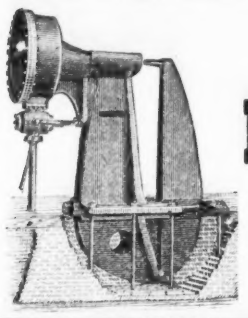

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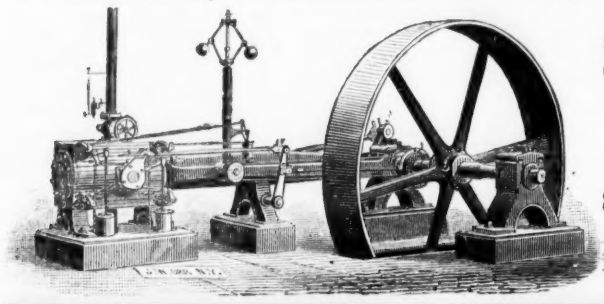

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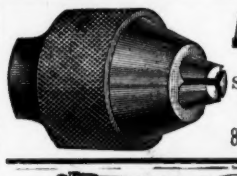

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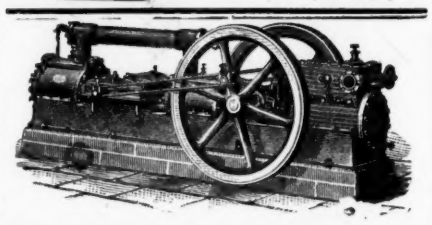

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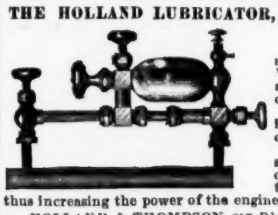

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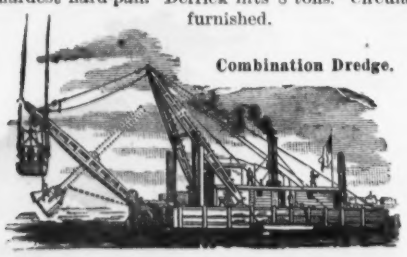
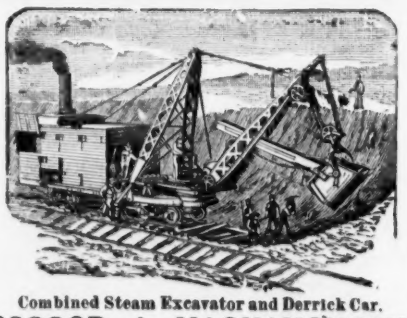
has a capacity of 4 cubic yards per minute in gravel. Has proved very efficient and desirable in the hardest hard-pan. Derrick lifts 8 tons. Circulars furnished.



Combination Dredge.



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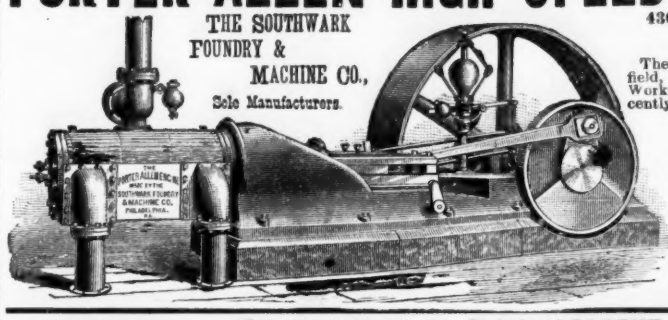
THE SOUTHWARK FOUNDRY & MACHINE CO., Sole Manufacturers.



The Springfield Iron Co., Springfield, Ill., and The Otis Steel Works, Cleveland, Ohio, each recently ordered their THIRD Porter-Allen Engine. The Cambria Iron Co., Johnstown, Pa., have put in, during the past year, their EIGHTH Porter Allen Engine, being 100 H. P. to run electric lights. The first Porter-Allen plant put in these works, six years ago, for rolling mill purposes, with same boilers and engines relatively equivalent to the former, doubled the output of the Works.

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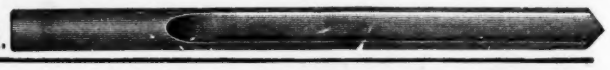

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Swivel Head Engine Lathes,

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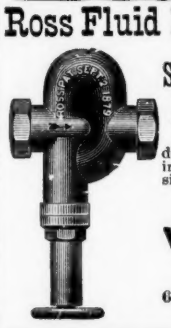

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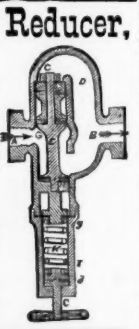

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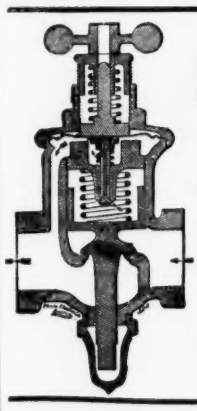

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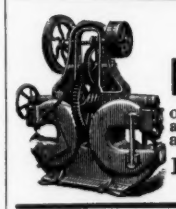

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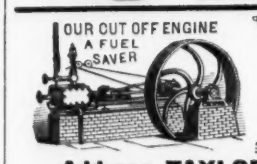

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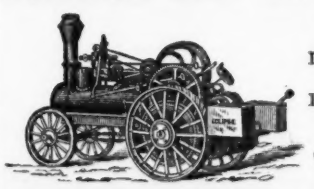

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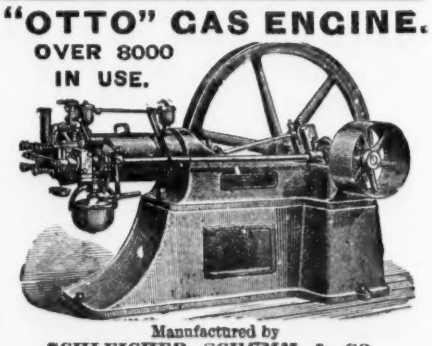

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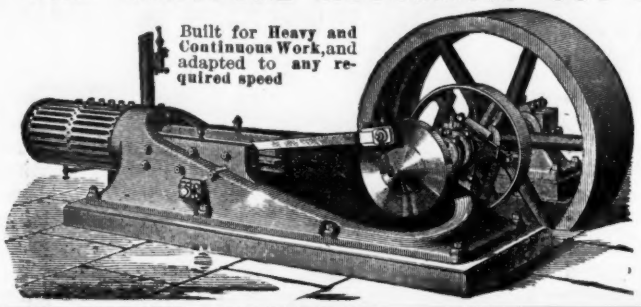

Built for Heavy and Continuous Work, and adapted to any required speed

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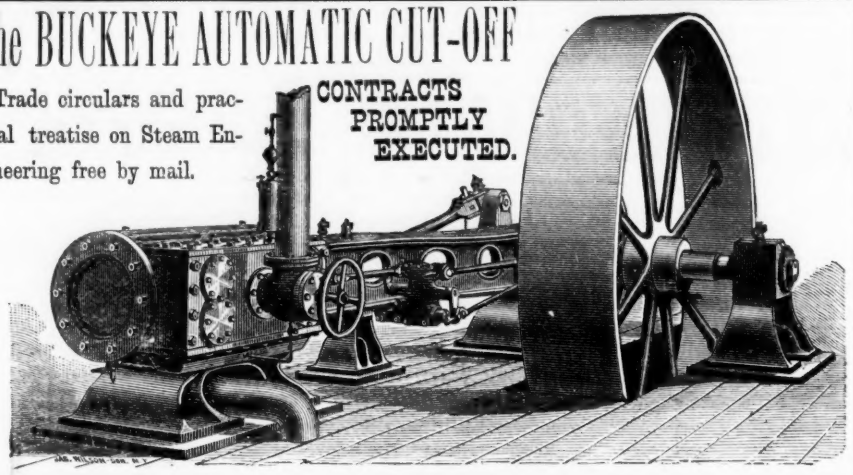

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EXHAUST-STEAM-INDUCTION
Always reliable. CONDENSER. Send for circular,

Will lift water without any pump. Operates equally well when supply flows to condenser from one foot fall or more. Requires no hot well, no elevated tail pipe, or tank. The most satisfactory results obtained.

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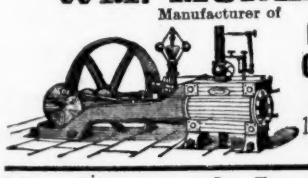

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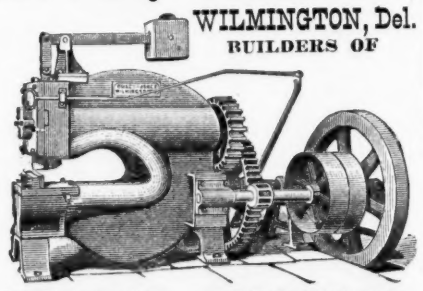

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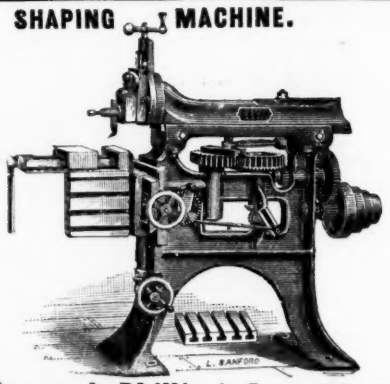

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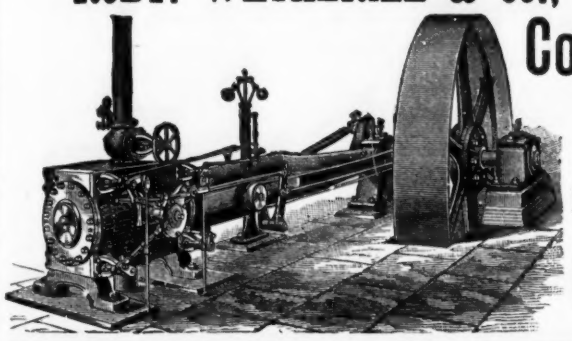

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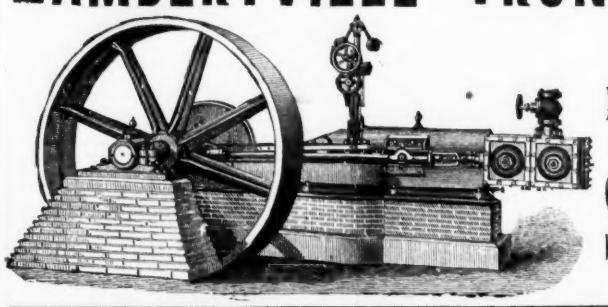

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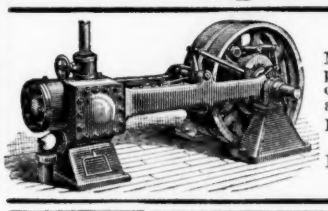

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Medium or high speed; uniform at all ranges of power or steam pressure; the fewest parts and working joints; the best material correctly distributed, and unexcelled in workmanship, balance, and smooth running.

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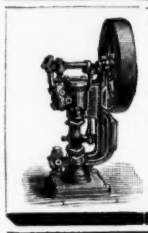

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PUMPING MACHINERY,
FOR ALL SPECIAL AND GENERAL PURPOSES.
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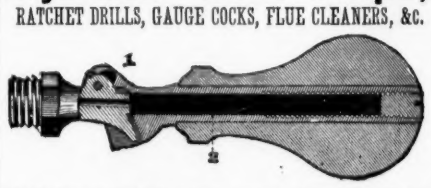

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MAKER OF FIRST-CLASS
ENGINE LATHES
Is now in position to put on the market
14" ENGINE LATHES OF NEW DESIGN
guaranteed to be equal in material, design and workmanship to the best ever offered.

FOR SALE.

We have the following second-hand Machinery for sale, viz.:

One Iron Planer, to plane 24 feet long, 62 in. x 62 in. square. It is powerfully geared, heavy and in good order.

One Planer to plane 61 in. x 61 in. x 20 ft. long.

One Planer to plane 54 in. x 54 in. x 16 ft. long.

One Planer to plane 15 ft. long 51 ' wide verygood.

One Iron Planer, to plane 12 feet long, 36 in. x 32 in. in fair condition.

One Iron Planer, to plane 12 feet long, 30 in x 30 in.

One Engine Lathe, will take 14 feet between centers, and swing 53 in over ways, has hollow spindle, and is adapted for both turning and boring, with countershaft. Complete.

One Engine Lathe, will take in 11 feet, 6 inches between centers, swings 48 inches over shears, and 32 inches over carriage. It has internal gear, and cross-feed, with countershaft. All complete.

One 3 ft bed, 9 in. Foot Power Screw Cutting Lathe, with tools.

One Slotting Machine, 12 in. stroke, slots to the center of 46 in. Adjustable table and universal feed motion.

One Combined Power Punch and Shears, to punch 5/8 and 1/2, and shear 1/2 in. iron.

Two No. 2 Pratt & Whitney Milling Machines. Very good.

One Axle Lathe, Fitchburg Machine Co.

One 12 in. Shaper, Lowell Machine Shop.

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Two 4 in Spindle Drills.

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Weight about 6000 lbs.

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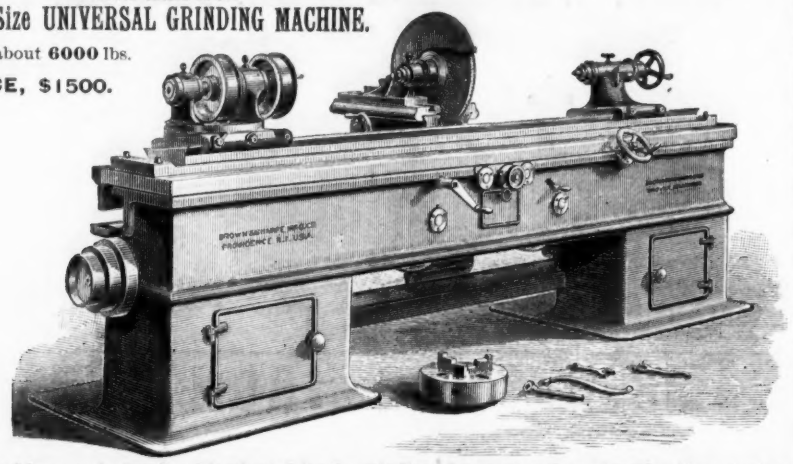

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BORING AND TURNING MILLS,

Driving Wheel Lathes.

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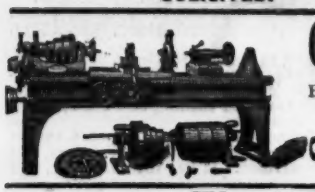

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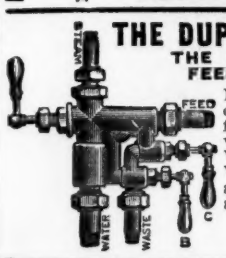

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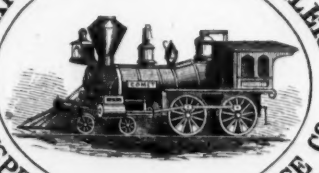

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